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THE HISTORY OF THE WOOL INDUSTRY IN WESTERN AUSTRALIA.

Being a broadcast by H. McCallum, Sheep and Wool Inspector, during Wool Week.

Wool—what a series of pictures this one short word can call to mind—(from the early settlement days until the present with its well-established farms and stations)—and what hardships and perils have been faced to lay a strong foundation for this very important industry in Western Australia.

Like every other industry, it has had its pioneering days, and the pastoralists, since the founding of the State, have ever been in the van of progress.

In the year 1829, over 1,000 sheep were brought to the Swan River Settlement, and were pastured near the Darling Ranges. Yearly other flocks were imported, and as early as 1832 a parcel of wool was shipped to London and realised 2s. 2d. per lb.

With the growth of the settlement the sheep-owners looked farther afield and travelled their flocks inland to the then wilderness in the possession of hostile blacks—the Toodyay-York district. Ever spreading, sheep owners then settled in the Geraldton and Irwin areas, and in 1834 sheep were pastured in the areas around Albany. In 1837 further sheep were imported for the southern parts of the State. Within ten years of the first settlement the wool-growing industry was more or less established, and through the years it has continued to develop.

The adventurous settlers gradually paved the way by exploring new areas, and by 1842 there were 60,000 sheep in the State, pastured from the districts northwards of Geraldton to the southern coast. At this time the weight of wool cut per sheep was very light, good clips averaging from 3½ to 4 lbs.

For the next twenty-five years wool-growing was practically confined to the same area—the South-Western Division of the State, and in 1861 the number of sheep totalled less than half a million.

Then reports from hardy explorers, who had pressed northwards and found new well-grassed areas, fired the imagination of a few enterprising colonists, and two years later they landed at Cossack with a few hundred sheep. This landing opened the first chapter in the volume of the conquest of the North, with its vast rich areas. These settlers held on and, though without the comforts of civilisation, daily in conflict with nature and treacherous blacks, with failure and disappointment threatening them often, successfully established their holdings.

Later expeditions into the interior brought forth the information that good sheep country abounded and flocks extended into the Upper Gascoyne, Murchison, Ashburton, and Kimberley districts. These big open spaces of the north soon became the chief home of the Merino.

With the number of holdings increasing annually, large numbers of high class sheep were imported, and special attention started to be given to improving the quality of the wool and endeavouring to increase the quantity.

By 1890 the number of sheep pastured had risen to 2½ millions, with a total wool clip of 9 million pounds weight, and 166 million acres were held under pastoral lease.

Whilst wool-growing had made amazing progress in the pastoral areas, it had been just steadily continuing in the South-Western Division, and it was not until the development of the wheat and mixed farming activities that it received an impetus in this area. As farming progressed, so the flocks increased and extended into new districts.

In 1910 the flocks totalled over 5 millions and the poundage of wool produced 26 millions.

Practically the whole of the wool produced in the State was exported prior to the year 1912, when great enthusiasm was created over an offering of 540 bales.

A movement of great importance during 1916-17 was the British Imperial Government Wool Scheme brought about by the war. All the wool grown in the State was received into stores at Fremantle, Albany, and Geraldton, where it was appraised under the jurisdiction of the Central Wool Committee on behalf of the Commonwealth Government. During the appraisements thousands of wool growers visited the wool stores to inspect the clips, and gained an education which was of inestimable value. This scheme operated for four years, and when it was terminated wool selling by auction was instituted. The opening sale under the new method was held in December, 1920.

Each season showed an increase in the quantity of wool submitted for sale, and soon the warehouse space was taxed to its utmost. The brokers then found it necessary to provide additional space, and the present commodious stores were erected for the accommodation and display of clips. These stores are modern, and the latest methods of receiving and displaying the wool have been adopted, with the result that they compare favourably with any stores throughout the Commonwealth.

Although progress in wool-growing is reported each year, it cannot be expected to make a uniform advance, as much depends on the seasons. 1927 was especially favourable and witnessed a wonderful expansion, the number of sheep increased by a million, and the clip by over 9 million pounds, and the average weight of fleece cut per sheep from 6.8 to 7.1 lbs.

Early in the present century stud-breeding of merino sheep was commenced in this State, as it was realised that large amounts of money were being sent out of the State annually in the purchase of flock rams. This innovation has proved a great success, and, in addition to keeping capital within the State, has two great advantages—the purchaser can inspect and personally select animals to meet the requirements of his flock, and the animals, being used to local conditions, do not suffer any setback through requiring to become acclimatised. At the present time all flock and general farming ram requirements can be met from the existing studs, where they have been bred from importations from the leading breeders in the Eastern States.

During the past fifteen years the industry has been greatly developed in the pastoral country to the northward of Kalgoorlie. Thousands of the best sheep were imported from the other States and these holdings stocked up, the wools from this district now making quite a large entry on the sale catalogue.

By the careful selection and breeding of sheep the average weight per head of wool cut has been increased, and in these days, when attention is being paid to the improvement of pastures by the use of superphosphates and the sowing of suitable fodders, we cannot estimate the future carrying capacity of the holdings within the State.

There are three areas from which wool is obtained:—the North-West and North; the Great Southern and South-West; and the Wheat Belt. Each wool is of a distinct type; that from the pastoral areas is much sought by Continental buyers, whilst Yorkshire shows a preference for that from the Southern and Agricultural areas.

The total production of wool for the 1930-31 season was 71½ million pounds, which is 4½ million pounds greater than the previous year. The total number of sheep pastured is about 10 million.

Closely connected with the wool industry is the breeding of lambs for market and the export trade, and this avenue of producing revenue is being rapidly explored. Last season 65,000 lambs were exported, and a great increase is expected. We have every advantage for engaging in this trade and should make a success of it. Our climate and also geographical position should enable our lambs to be on the English market ahead of any others in the Commonwealth.

There are about 9,000 wool-growers in the State, and these with their families total some 40,000 persons directly dependent on wool-production. There are thousands of other people, though not direct producers, who rely on wool for their employment. When wool prices are high, the whole community shares in the benefits therefrom, and, similarly, falling prices cast a shadow on all. It therefore behoves us all to do our best to promote wool sales; we should become "wool conscious" and select clothing made from good West Australian wool manufactured at the Albany mills. Make "wool week" unite us in the use of more wool and so promote prosperity in our midst. When the producer can say "all's well" then "all's well" with the West.

And in conclusion, a tribute to the pioneers of our State is due. We to-day are reaping the benefits of their enterprise, courage and patient endurance, and history records no higher heroisms than those of the brave men and women who penetrated into the unknown of a new land to lay the foundation of what is to-day one of our State's main industries.

"CLASSING THE CLIP."

C. E. COWLEY.

I have read with interest this publication and consider it is very instructive on the handling of the wool from the sheep to the factory. All branches of the work are dealt with in a very clear manner and expressed in simple language, making it easy for the very beginner to grasp the procedures outlined and the objects at which to aim.

From the point of view of wool growers in this State, however, there are two minor points which may be a little misleading.

The use of the word "Canary" to indicate the depth of yellow in "yolk stained" wool (page 44).

"Canary" stained wool as known in Western Australia cannot yet be said to be due to the presence of an over-abundant supply of yolk. To date the cause of this stain in wools from the Northern pastoral areas of Western Australia has baffled scientists, and is still being investigated. "Canary" stain, even in the very slightest tinge, cannot be scoured out of the wool, whereas "yolk" stain, unless exceptionally deep and bright, will yield to scouring.

Classing.—The formation of lines does not coincide with those advocated in this State.

The Western Australian top lines are usually marked Super, A.A.A., A.A., A., whereas the lines suggested in Mr. Cowley's book are marked Super, 1st, Second, "A."

HUGH McCALLUM,
Sheep and Wool Inspector.

10th July, 1931.

SUMMER FODDER CROP COMPETITION.

C. GILES, Dairy Instructor.

In order to encourage the growing of summer fodders, the Royal Agricultural Society offered prizes for the best crops of summer growing plants in each of three Zones into which the State was divided. In addition a Special Prize of £5 was to have been awarded to the competitor producing the highest yield per acre in any Zone irrespective of other points.

The following shows the boundaries of the three Zones:—

Zone 1.—Country north of a line running from the coast due east through Dardanup to the Great Southern Railway Line.

Zone 2.—A line from the southern boundary of Zone 1 due south through Boyup Brook to the coast. All country west of this line and bounded by the coast to be in Zone 2.

Zone 3.—Districts south of Zone 1 and east of the eastern boundary of Zone 2 embracing the Denmark district.

The summer proved an exceedingly long one, and very little rain fell throughout the whole of the South-West during this period. Moreover, the cultivation

of fodder crops did not receive the attention warranted, with the result that not only were very few entries received but that the cream supplies from many farms, and indeed districts, fell considerably as compared with previous years through the lack of green fodder for cattle.

Only three entries were received in Zone 1 and finally judged as, owing to the unfavourable season, fodder crops generally have not been a success. The three entries judged, however, were all good crops, though not up to the standard of previous years.

The following points were allotted:—

A. W. Gibbings, Coolup—96 points.

H. Hardy, Cookernup—90 points.

L. Pearson, Benger—83 points.

The detailed points were allotted as follow:—

——	A. W. Gibbings, Coolup.	H. Hardy, Cookernup.	L. Pearson, Benger.	Total points allowed.
Yield based on feed value per acre	50	42	40	50
Freedom from weeds	15	15	15	15
Cultivation	12	15	12	15
Freedom from Disease	10	9	8	10
Evenness of growth	9	9	8	10
	96	90	83	100

Winning Crop of Maize. A. W. Gibbings, Coolup.
Yield 14.34 tons per acre.

Rainfall.—The average annual rainfall for Brunswick Junction, the nearest station, taken over the last 33 years, was 41.54 inches. The rainfall which occurred during the growing period (November to February) was 101 points, the monthy precipitation being as follows, the season, therefore, being an unusually dry one:—

November	19 points.
December	44 „
January	38 „
February	Nil
Total	101 points.

The following are particulars regarding the method of cultivation:—

——	A. W. Gibbings.	H. Hardy.	L. Pearson.
Weights taken	Feb. 10th ...	Feb. 15th ...	Feb. 4th
Drills apart	30in.	36in.	27in.
Average height	9ft. to 10ft. ...	7ft. 6in. ...	5ft.
Fertiliser—rate per acre ...	Super. 3 cwt. ...	Super plus Sulph. Ammonia, mix. 3 to 1, 3 cwt.	Super. and Ammonia. No. 2—3 cwt. p.a.
Soil	Black swamp ...	Sand and clay loam	Clay to sandy
Date of Seeding	December ...	Nov. to Jan. ...	Mid-December
Approx. Germination per cent.	95 per cent. ...	80 per cent. ...	70 per cent.
Estimated Weight per acre (tons)	14·34	10·71	9·6

PASTURE EXPERIMENT PLOTS—DENMARK STUD FARM.

G. K. BARON-HAY, Superintendent of Dairying, and
G. E. ELLIOTT, Agricultural Adviser.

With the object of proving and testing varieties of pasture and fodder plants which may be suitable for the extreme South-West portion of the State, experimental and trial plots have been inaugurated at the Denmark Stud Farm. Various species were planted with a view to demonstrating their—

(a) persistency;
(b) habits of growth;
(c) suitability for pasture or fodder in that district.

The State Stud Farm is situated close to the Denmark township, about 250 miles in a southerly direction from Perth. The surrounding country is hilly, but on the farm the ground is more or less even with gentle slopes.

The plots are situated on land which was originally heavily timbered with karri (*E. diversicolor*). The soil is a medium loam with small outcrops of granite, the surface having a tendency to set when dry. Drainage into the Denmark River is good, and the soil—if cultivated—is retentive of moisture during the summer.

The rainfall for the season April, 1931, to March, 1932, and the mean annual rainfall for 1931, are shown in the following table:—

Month.	1931.	Mean Annual Rainfall.
	inches.	inches.
April	4·39	3·48
May	6·19	5·88
June	6·12	6·93
July	9·05	7·62
August	7·18	6·56
September	7·22	5·38
October	2·38	4·47
November	0·61	1·87
December	2·56	1·45
	1932.	
January	0·56	1·12
February	0·95	1·49
March	1·10	2·27
Total	48·31	48·52

The above table shows that the average annual rainfall for Denmark is 48.52 inches, and that the major portion of the rain falls in the winter months, with a relatively moderate precipitation during the summer. The fall for the summer just passed was 334 points below average, and for the five months October to February the rainfall registered was only 706 points.

The following gives a brief outline of the cultural methods and the observations noted from the time of planting and up to May of this year:—

Cultivation.—The land was well worked to make a fine even tilth for the seed bed.

Seeding.—The different varieties of seeds were planted in ½-chain rows with 3 links between each variety.

Rate of Seeding.—⅛ ounce of seed was sown per row and lightly covered, equalling approximately 20 lbs. per acre.

Fertiliser.—2 cwts. of superphosphate and ½ cwt. of sulphate of ammonia per acre were applied before seeding.

LEGUMES.

Lucerne (Medicago sativa).—On 5th June, 20 different strains were planted, but owing to the ravages of the lucerne flea and red mite it was necessary to resow three times. The last sowing was carried out on the 9th October and a good germination resulted. Six weeks later it was evident that the "Hunter River," "Spanish," and "Mudgee" varieties were making the most headway.

From that time until the end of February all rows were cut twice, and the result showed that the "Hunter River" was still the most outstanding strain, with "Mudgee," "Tamworth," "Poitore," "Province," "Montana," "Dakota," and "Kansas" thriving well.

In May it was noticed that the lucerne flea was present and doing considerable damage.

The "Hunter River" was still ahead of the others, but was closely followed by the "South African," "Peruvian," "Marlborough," "English," "North Californian," "Poitore," "Spanish," "Mudgee," and "Tamworth" in that order.

The above indicates that of the 20 strains planted the "Hunter River" is the best, being the first to come away and following up by producing the best bulk, being closely followed by the "Mudgee" early in the summer and the "South African" later towards the autumn.

The "Chinese" and "Mongolian" strains are distinct in habit from the rest, being more prostrate, having smaller foliage, shorter growth, and producing the least bulk.

These results with lucerne, which are corroborated in other areas, point to the very difficult establishment of lucerne when planted in autumn. *It would seem that spring planting is essential.*

Red Clover (*Trifolium pratense perenne*).—Of the 10 strains planted on the 6th June, it was noticeable from the time they germinated that all were practically untouched by the lucerne flea and only slightly affected by the red mite. In the earlier stages of growth it was soon noticed, however, that the "English Late Flowering" and the "American Mammoth" were the most prominent and making the best growth and bulk.

An the end of February the "American Mammoth," "English Late Flowering," and the "Montgomery Red" were giving the best results, and in May these three were superseded by the "Italian" strain. The "Late Flowering Cornish Marl" was the only one which failed owing to bad germination.

With the Red Clovers, the results indicate that the "American Mammoth" and the "English Late Flowering" are the most outstanding, and all strains were only slightly attacked by the lucerne flea and red mite.

The very valuable observations during the past season *that the Red Clovers are comparatively resistent to lucerne flea* indicate an important place this variety of clover may have in farming practice, where the ravages of the lucerne flea are serious.

White Clover (*Trifolium repens*).—On 9th June nine rows were planted with White clover. Of these, six were Wild White Clovers of English and New Zealand origin. From the time of germination, all rows suffered very severely from attacks of the lucerne flea and red mite, but not severely enough to necessitate resowing.

The early growth of these clovers was poor, but from November onwards they made rapid progress. It was then evident that the "Dutch," "Giant English," and "Lodi Mammoth" had larger foliage, produced more bulk and uneven growth than the Wild White Clovers, which were prostrate in habit, having smaller foliage, growing slower and more persistent. It was evident in May that the "White Dutch" and "Giant English" were the best bulk producers. Of the "Wild White" varieties, the New Zealand strain was the best, being closely followed by the "Kentish" old pasture.

From the first season's results, it appears that to obtain a good bulk the first year the White Clovers are superior to the Wild White Clovers, but for evenness of growth and persistency the New Zealand "Wild White" is the most outstanding, and would not be damaged to the same extent by grazing as the White Dutch Clover.

MISCELLANEOUS LEGUMES.

Subterranean Clover (*Trifolium subterraneum*).—An annual which produced an excellent stand, but was very severely attacked by the lucerne flea and red mite in the earlier stages.

Lotus corniculatus.—The germination of this trefoil was only fair, and no real headway was made until after November.

This variety of *Lotus proved very resistant to attacks from the lucerne flea and red mite,* and for this reason may prove most important in pasture mixtures, in addition to which this plant proved very persistent.

Sulla (*Hedysarium coronarium*).—The germination and subsequent growth of this plant was poor. Lack of the proper nitrogen-fixing bacteria may account for the poorness in growth.

GRASSES

Rye Grasses (*Lolium spp.*).—Four rows containing three perennial and one Italian strain were planted on 16th June. Germination in all rows was exceptionally good.

Early observations indicated that the Italian Rye Grass was making the best growth, but later on towards the summer the perennials produced equally as large a bulk of herbage.

Portions of the rows were subjected to continual cutting, with the result that exceptional growth was obtained in the cut portions of all rows.

In April it was noticed *that the Italian Rye Grass was not making the same recovery as the perennials,* and that it was practically impossible to distinguish the difference in growth and habit of the three perennials, with the "Irish" strain being slightly superior to the "Kentish" and "Tabor" strains.

It is intended this year to include a number of New Zealand strains for comparison.

Timothy (*Phleum pratense*).—Of the four strains planted on the 16th June, all germinated well but did not make much growth until early in November. At no time during the year could their growth be regarded as good. The most outstanding strain was the pedigreed Welsh, but even this did not produce an even growth.

Cocksfoot (*Dactylis glomerata*).—Three imported strains of Cocksfoot were planted on 15th June; a good germination resulted. All of these made good growth, standing up well to the dry summer.

MISCELLANEOUS GRASSES.

Fescue (*Festuca rubra*).—The germination of the two plots grown was excellent. Both produced a good even stand of fine grass. This species may prove useful when incorporated as a bottom grass in pastures.

Wheat Grasses (*Agropyron spp.*).—Both the "Slender" and "Crested" Wheat Grasses were planted. Early in the season they came away very slowly, but during the summer the "Slender" Wheat Grass produced a fair bulk nearly equal to that of Cocksfoot. Both withstood the summer and are doing well. The "Crested" Wheat Grass is much more prostrate in habit than the "Slender."

Of the other grasses growing, those showing most promise are *Brome Grass* (*Bromus sp.*), *Tall Oat Grass* (*Arrhenatherum elatius*), and *Dhaman Grass* (*Pennisetum sp.*). The "Tall Oat Grass" had made exceptionally good even tufty growth and produced a good bulk of feed.

MISCELLANEOUS.

Of the 10 miscellaneous fodder plants grown, the following have survived the summer months and produced a good bulk of feed:—Sheep's Burnet, Sheep's Parsley, and Chicory. Of the remaining, Tree Lucerne (*Cytisus sp.*), Ribgrass (*Plantago lanceolata*), and *Plantago maritima* are the best.

WOOL WEEK.

HUGH MCCALLUM, Sheep and Wool Inspector,
and
W. McC. JOHNSON, Cadet.

Westralia's "Wool Week" has proved a great success and should give a stimulus to the wool industry.

Dame Fashion this season has sided with the primary producer and decreed that woollen material shall be "the cloth" for the winter, and with the revival of hand knitting the spending power of the feminine section of the community, at least, will be diverted to the purchase of wools. For many years wools have been used in the manufacture of "flock" for filling mattresses, upholstery, etc., but this year its use, after simply scouring and teasing, is being advocated for bedding, pillows, quilts and cushions, and this should absorb a large quantity of the cross-bred wools that do not find such a ready market for the overseas trade.

Great interest was manifested in the "Wool Queen" competition, and Miss Coyne is to be congratulated on gaining first place. The "Miss Westralia" frock competition was a most successful effort, and had the support of many country centres, and the organisers must feel very proud of the result of their labours. The entries in the many knitting and frock competitions conducted by the different firms have been numerous and some splendid work is to be seen.

Some wonderful displays, depicting the stages in manufacture and the many uses to which wool can be put, have been arranged in the windows of all the leading firms, and, judging by the crowds gathered round the windows, the man in the street, together with his wife, daughters and sons, found them most interesting and, no doubt, instructive. Several of the shops arranged for an expert hand knitter to be in attendance to give instruction and assist amateurs in making up the wool purchased, and in every case the knitter has had a large and varied class each day.

The Empire procession had a special section for wool, and the leading float gave pride of place to a very fine ram, the imposing sire of Westralia's wool producers, mounted on a hillock of wool and gazing proudly down on the exhibits manufactured from the coats of his many relations. An old time drag carried many members of the old pastoralist families, and the Premier rode in state on the driver's seat. The pioneers, pastoralists, boundary riders all took their part, even to several native inhabitants of the State. One large lorry drawn by five magnificent horses, carried 40 bales of wool, showing the early method of transport. The float of the metropolitan surf-clubs added a note of colour with the members in their gay woollen parade costumes manning a surf boat. They showed how attractive well-knitted woollen material could look, and yet permit of easy movement and every comfort, and how they, in addition to saving the lives of those in danger from the sea, were helping to save the pastoralists by increasing the demand for woollen goods.

In the industrial section were some very fine exhibits of woollen goods which, by their quality, clearly demonstrated the vast improvement which has been made in the manufacture of woollens locally. With the wide variety of choice materials and designs now available at the various local mills, it is rather astonishing to see that Westralia imports any woollens at all.

With the interest and support that has been given to "Wool Week," there can be no doubt that the public is keenly aware that the future prosperity of the State depends largely on her woollen industry and is doing its best to stand firmly behind it.

PURITY OF RYE-GRASS STRAINS.

THE USE OF FILTERED ULTRA-VIOLET LIGHT IN DIAGNOSIS OF THE VARIOUS TYPES OF RYE-GRASS (*Lolium spp.*).

H. G. Elliott, Agric. Adviser, Dairy Branch.

Owing to the extreme difficulty in detecting de-awned Italian Rye-grass (*Lolium perenne* var. *multiflorum*) in samples of perennial rye-grass seed (*Lolium perenne*), the recent discovery by Dr. G. Gentner of the State Seed Control Station, Munich, is a matter of outstanding importance. He demonstrated that seedling roots of Italian rye-grass grown on white Whatman filter paper cause a condition on the paper which when viewed under filtered ultra-violet light of the 3,000/4,000 Angström Unit Band would render it fluorescent, while the seedlings of pure perennial rye-grass under identical conditions would not.

Linehan and Mercer, of the Department of Agriculture, Northern Ireland, applied Gentner's method to the commercial rye-grasses of Great Britain, with the result that the phenomenon of fluorescence was found not to be confined to Italian rye-grass, as other annual species of *Lolium* and certain other plants, such as oats, do so brilliantly, and that it is possible to distinguish seeds of perennial rye-grass from de-awned seeds of Italian rye-grass by this method within a marginal error of 10 per cent. They found also that certain seedlings of apparent perennial rye-grass are found to exhibit fluorescence, which by "growing-on" tests were identified as intermediate false perennials.

N. R. Foy, of the Plant Research Station, Palmerston North, New Zealand, tested out over 500 samples, the majority of which had been previously classified by plot trials. He considers from the evidence he obtained that the value of the quartz lamp in the diagnosis of potential plant-type in rye-grass has been established, and states that "it must be accepted that—

"(a) Genetically pure perennial does not exhibit flourescence, or is always negative;

"(b) Genetically pure Italian does exhibit fluorescence or is always positive;

"(c) The hybrid individual may or may not exhibit fluorescence;

"(d) For each of the classes of rye-grass there is a more or less definite proportion in which the positive and negative reacting individuals occur;

"(e) The proportion of fluorescent individuals is smallest in the most persistent class and greatest in the least persistent class; there is a distinct negative correlation between the proportion of fluorescent individuals characteristic of the class and the degree of persistency."

Experiments conducted by this department have been very satisfactory. This application of the ultra-violet light test to all trade samples would hasten the disappearance of the less persistent types of rye-grass.

The writer wishes to acknowledge his indebtedness to Mr. H. L. Ball, of Messrs. W. Watson and Sons, Perth, for the use of apparatus for the tests already carried out.

EXPERIMENTS WITH "RHENANIA" PHOSPHATE IN WESTERN AUSTRALIA.

L. J. H. TEAKLE, G. K. BARON-HAY, I. THOMAS, Department of Agriculture.

The advance of the sciences of chemistry and engineering has enabled the fertiliser manufacturers to produce better and cheaper fertilisers for the maintenance and improvement of soil fertility. There is now no need to fear a shortage of nitrogenous fertilisers. Similarly, more concentrated and readily available phosphatic fertilisers are produced more cheaply as a result of improvement of technique and the introduction of new methods.

"Rhenania" phosphate, one of these products, is the result of the use of a new method of treatment of rock phosphate. It is a concentrated fertiliser supplying 25-30 per cent. ammonium citrate soluble phosphoric oxide (P_2O_5) in the form of a calcium-alkali phosphate. The ground rock phosphate is heated in a rotatory furnace to a temperature of 1,100deg. to 1,200deg. C. with alkali salts. A chemical change occurs whereby two-thirds of the calcium is replaced by the alkali metal giving an available phosphate, soluble in ammonium citrate. The mass is removed from the furnace as a clinker and is then finely ground and sold as a light grey powder under the name of "Rhenania Phosphate." The availability of the phosphate compares with that of dicalcium phosphate. It is alkaline in reaction due to calcium silicate and in this respect resembles basic slag.

As a fertiliser it has been studied extensively in Germany and to a less extent in other parts of the world. Niklas, Strobel and Scharrer (1) organised a comprehensive plot experiment to compare "Rhenania Phosphate" with superphosphate and Thomas phosphate. He found that "Rhenania Phosphate" and superphosphate gave similar increases in yield of barley, wheat, oats, spinach, sugar beet, lucerne, etc., and were superior to Thomas phosphate.

Further experiments by the same authors (2) on four different types of soil led to similar results with oats, potatoes, rye, barley and beans.

von Rath (4) concluded that Rhenania phosphate was superior to superphosphate for cereals and equal to superphosphate for sugar beet. The cost for each fertiliser was the same.

These and other results aroused an interest in Rhenania phosphate as a fertiliser. Through the courtesy of Privatdozent Dr. L. Meyer, of the Plant Nutrition Institute at Hohenheim, Germany, arrangements were made with the Kali-Chemie Company for the provision of a parcel of this fertiliser for experimentation in Western Australia. A parcel of 1,000 kilograms (approximately one ton) was supplied gratis and this was used by the Wheat Branch and the Dairy Branch of the W.A. Department of Agriculture in experiments in 1930 in various parts of the State. The Rhenania phosphate was compared with superphosphate—

1. When the same weight of fertiliser was used per acre.
2. When the same weight of phosphoric oxide (P_2O_5) was used per acre.

A.—THE RESULTS WITH WHEAT.

The results with wheat have been published by Thomas (5).

The trials were arranged at the Merredin Experiment Farm, about 170 miles East of Perth, and at the Wongan Hills Light Lands Farm, about 130 miles North of Perth.

1.—*At Merredin Experiment Farm.*

The experiments at Merredin were on the typical heavy textured forest soil of the Mallee Zone (Prescott (37)) of Western Australia. This zone receives an annual precipitation of 11 to 16 inches, of which 60 to 70 per cent. falls in the cool season (May to October).

The properties of the soil are represented by the analysis of Prescott (3) which is reproduced in Table 1.

Table 1.

COMPOSITION OF A TYPICAL GIMLET (EUCALYPTUS SALUBRIS) SOILS OF THE MALLEE ZONE (PRESCOTT (3).)

Merredin, Western Australia.

Depth in inches	0—4ins.	4—12ins.	12—18ins.	18—28ins.	28—42ins.
Horizon	A.	B_1.	B_2.	B_3.	B_3C.
	%	%	%	%	%
Coarse sand	36·7	21·5	16·9	15·3	16·9
Fine sand	23·3	15·9	14·7	13·6	14·1
Silt	14·9	12·8	13·8	10·4	7·2
Clay	20·8	43·0	46·2	48·8	43·4
Loss on acid treatment	0·5	0·8	1·4	5·3	12·6
Moisture	3·2	6·6	7·9	8·1	6·3
Loss on ignition	5·4	6·8	6·9	8·0	10·5
Nitrogen	0·06	0·05	0·05	0·03	0·02
Carbon	1·01	...	...	...	...
Calcium carbonate	0·02	0·02	0·26	4·40	11·80
Sodium chloride	0·02	0·06	0·17	0·17	0·25
Reaction—pH	6·7	7·4	8·2	8·6	8·8

The land had been under cultivation for about 25 years and during that period had received applications equivalent to from 5 to 6 cwts. per acre of superphosphate containing 22 per cent. P_2O_5. The early variety, Gluyas Early, was sown at the rate of 45 lbs. of graded seed per acre, with the requisite amount of phosphatic fertiliser in a grain and fertiliser drill on well prepared fallowed land.

The season was average in total rainfall, but was dry in May, September, and October, thereby reducing yields. For 1930 the precipitation was 13.33 inches, of which 8.23 inches fell in the months of May to October.

2.—*At the Wongan Hills Light Lands Farm.*

This district generally receives a slightly heavier rainfall than at Merredin and a greater portion (70 to 80 per cent.) falls in the May to October season. For 1930 the precipitation was slightly less than Merredin; 12.99 inches, of which 10.48 inches fell in the May to October period, were recorded at Wongan Hills Light Lands Farm.

The soil is a grey sand on yellow sand with more or less lateritic pebbles through the mass. It is formed from ancient laterites or similar material, and in no way resembles the normal soils of the district. It is of low inherent fertility and carries a low scrub of harsh shrubs. The soil is slightly acid in reaction, giving a pH 5.5-6.0 (quinhydrone electrode) and is so deficient in available phosphate that no growth of cereals is obtained without phosphatic fertilisation.

The plots were on fallowed land which had not previously carried a crop nor received any fertiliser treatment. The midseason variety "Nabawa" was sown at the rate of 45 lbs. of graded seed per acre with the requisite fertilisers in a grain and fertiliser drill.

Table 2, taken from Thomas (5), summarises the results obtained with wheat in the 1930 season at the Merredin and Wongan Hills Experiment Farms.

TABLE 2.

COMPARISON OF RHENANIA PHOSPHATE WITH SUPERPHOSPHATE AS AFFECTING THE GROWTH OF WHEAT AT THE MERREDIN EXPERIMENT FARM AND THE WONGAN HILLS LIGHT LANDS FARM, 1930.

Rhenania Phosphate—28·4 per cent. Phosphoric Oxide—(P_2O_5)

Superphosphate—22 per cent. Phosphoric Oxide—(P_2O_5)

(Figures are averages of yields from five replicated plots, all plots similarly treated giving concordant results.)

Fertiliser Treatment.	Merredin Experiment Farm—1930 Season.		Wongan Hills Light Lands Farm—1930 Season.	
	Average Yield, bushels per acre.	Per cent.	Average Yield, bushels per acre.	Per cent.
150lbs. per acre Rhenania phosphate	29·8	97	9·5	55
150lbs. per acre Superphosphate (control)	30·7	100	17·3	100
110lbs. per acre Rhenania phosphate (equivalent P_2O_5)	28·7	94	8·4	49

B.—RESULTS WITH PASTURE.

The results of the experiments with pasture carried out by the Dairy Branch have been made available by Mr. G. K. Baron-Hay in a departmental communication. The experiments were arranged in the high rainfall districts in the South-Western portion of the State South of Perth. The fertilisers were applied as top dressings and the results compared with the yields of the plots treated with superphosphate. The yields were estimated from cuttings made at one or two periods.

The soils used cover a representative range in the clover belt of Western Australia. They are generally slightly acid in reaction and enjoy a rainfall ranging from 30 to 50 inches per annum.

The results reported by Mr. Baron-Hay are summarised in Table 3.

The experiments were arranged in triplicate and the yields calculated by averaging the weights of green herbage obtained from measured quadrats taken at five sites on each plot. The yields of individual plots under similar treatment varied considerably in certain cases so that small differences are not significant. From the summary in Table 3, it appears that generally Rhenania phosphate is not equal to superphosphate as a source of phosphate under the conditions in this district.

TABLE 3.

SUMMARY OF RESULTS OF EXPERIMENTS WITH SUPERPHOSPHATE AND RHENANIA PHOSPHATE ON PASTURE IN THE SOUTH-WEST OF WESTERN AUSTRALIA, 1930.

Superphosphate—22%, P_2O_5. Rhenania phosphate, 28·4%, P_2O_5.

Weights given are for green material harvested.

Farm.	District.	Rainfall inches per year.	Cutting.	Date, 1930	Superphosphate, 150 lbs. per acre (Control).		Rhenania Phosphate 110lbs. per acre.		Rhenania Phosphate 150lbs. per acre.	
					Tons per acre.	Per cent.	Tons per acre.	Per cent.	Tons per acre.	Per cent.
W. Harding ...	Brunswick ...	41·97	First ...	Nov. 26	8·79	100	6·42	73	8·12	92
F. C. Smith* ...	Denmark ...	49·21	First ...	Sept. 20	8·75	100	8·53	97	7·78	89
F. Nuttman ...	Ambergate, Group 44	32·04†	First ...	Sept. 17	0·36	100	0·34	94	0·38	106
Do. ...	do. ...	...	Second...	Nov. 20	8·19	100	6·69	82	6·48	79
J. W. Pritchard*	Jardee ...	39·21‡	First ...	May 10	5·04	100	3·13	62	3·18	63
Do. ...	do. ...	...	Second...	Nov. 27	6·26	100	4·18	67	4·09	65
C. Somerset ...	Balingup ...	39·21‡	First ...	Aug. 21	5·58	100	4·86	87	5·00	90
L. Temple ...	Harvey ...	40·25	First ...	Nov. 22	5·00	100	4·60	92	4·00	80
Average percentage yield (Superphosphate Control)					...	100	...	82	...	83

Farm.	District.	Rainfall inches per year.	Cutting.	Date, 1930	Superphosphate, 112 lbs. per acre (Control).		Rhenania Phosphate 112lbs. per acre.	
					Tons per acre.	Per cent.	Tons per acre.	Per cent.
C. Collins ...	Denmark ...	49·21	First ...	Nov. 16	10·97	100	11·52	105
E. W. Grinham	Wonnerup ...	32·04†	First ...	Sept. 17	3·24	100	4·03	124
Do. ...	do. ...	...	Second...	Nov. 20	8·77	100	9·00	103
Average percentage yield (Superphosphate Control)					...	100	...	111

* Experiment in duplicate only. † Record from Busselton. ‡ Record from Greenbushes.

In certain cases the plots receiving Rhenania phosphate gave slightly superior measured yields. In view of these cases, it must be concluded that under certain conditions Rhenania phosphate is equal to superphosphate in improving the growth of pasture in the clover belt, but generally the yields from superphosphate treated pastures are superior.

GENERAL DISCUSSION.

The results of these experiments point to the general superiority of the water soluble phosphate under Western Australian conditions for wheat and pasture production. The response varies with the soil and in certain cases Rhenania phosphate proved equal to superphosphate, within the limits of experimental error. At Merredin the yield from wheat grown with Rhenania phosphate proved almost equal to the yield from the superphosphate plots. At this farm the residual effects of previous dressings of superphosphate is apparent, as when phosphate is withheld on these cultivated soils, the depression in yield amounts to 40 to 50 per cent. At Wongan Hills, where the soils are exceptionally deficient in phosphate, the response to superphosphate is phenomenal, and the water soluble phosphate proved greatly superior to the ammonium citrate soluble phosphate.

Results taken from Thomas and Langfield (6) and Thomas and Venton (7) are summarised in Table 4.

TABLE 4.

EFFECT OF SUPERPHOSPHATE ON THE YIELD OF WHEAT AT THE MERREDIN EXPERIMENT FARM AND THE WONGAN HILLS LIGHT LANDS FARM.

YIELDS OF WHEAT.

Application of Superphosphate, 22%, P_2O_5. (lbs. per acre).	Merredin Experiment Farm.				Wongan Hills Light Lands Farm.	
	1929.		1930.		1930.	
	Bushels per acre.	Per cent.	Bushels per acre.	Per cent.	Bushels per acre.	Per cent.
Nil	16·5	60	12·9	46	*Nil*	...
75lbs.	25·2	91	25·2	90	12·5	82
150lbs.	27·7	100	28·1	100	15·2	100

Unit Values.—The unit value of Rhenania phosphate is lower than that of superphosphate when calculations are based on the quoted price in the country of manufacture. The comparison is shown in Table 5.

TABLE 5.

UNIT VALUES OF RHENANIA AND SUPERPHOSPHATE.
(one unit = 22·4lbs., P_2O_5, or one per cent. of one ton).

Fertiliser.	P_2O_5	Cost.	Country.	Unit Value.
	%	£ s. d.		s. d.
Rhenania Phosphate	28·4	5 3 9	Germany ...	3 8
Do. do.	...	8 10 0	W.A. ...	6 0
Superphosphate	22·0	...	W.A. ...	4 0

It is seen that freight charges would prohibit the importation of Rhenania phosphate as a commercial proposition. While high grade superphosphate can be made cheaply, it does not appear likely that the manufacture of this fertiliser is justified in Australia as the return from the phosphate used is somewhat in favour of the superphosphate, more especially on extremely phosphate hungry soils.

The technical process of manufacture is a radical departure and deserves consideration. It may prove a means of utilising low grade phosphatic rock when the high grade material is not so readily available.

SUMMARY.

In this paper are described experiments in which the effect of Rhenania phosphate and superphosphate on the growth of wheat and pasture in Western Australia are compared.

The yields from Rhenania phosphate plots were generally inferior to yields from superphosphate plots. On certain soil types, in certain cases, however, the response to both fertilisers was approximately equal.

It is improbable that Rhenania phosphate would be able to compete with superphosphate under present Australian conditions.

The Department of Agriculture is indebted to the Kali-Chemie Company, Germany, for supplying the parcel of 1,000 kilograms of Rhenania phosphate gratis for experimental purposes. Thanks are extended to the company for the opportunity to study this new and effective type of phosphatic fertiliser.

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THE SOWING OF PASTURE SEEDS.

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During recent months a considerable and growing interest has been exhibited by farmers in the possibilities of improving the quality of pasture on various types of soil. This has led to numerous inquiries being received by the Department, particularly requesting information regarding the types of soil suitable for the growing of different strains of pasture plants and the rates of seeding recommended for these varieties. It, therefore, is hoped that the following notes setting out briefly the preparation of the soil required for the sowing of pasture seeds, and also the types of plants recommended for varying districts, will serve as a guide to those farmers desiring to improve or resow portions of their land to pasture.

Preparation of the Soil.—Whatever the type of soil to be planted, it is essential, in order to secure good germination, that the surface soil be of a fine tilth and that beneath this surface layer, which should be shallow, say, ¾ of an inch, the seed bed should be well consolidated.

Where mixtures containing perennial grasses are included, it is requisite that the soil should be fertile, and it therefore is undesirable, as a rule, to sow these types of pasture plants on virgin soil.

The land to be planted should be fallowed in spring, cultivation being carried out during the summer months to consolidate and also to destroy germinated weeds. Where the soil is poorly drained, ploughing should be carried out in narrow lands.

The growing of a crop of potatoes or maize during the previous summer may obviate the leaving of the land fallow, and has the effect also of enriching the soil, as these crops usually receive a heavy dressing of fertiliser containing nitrogen. Some form of summer cultivation such as that indicated above is necessary, so that the seeds may be planted and germinate early in autumn while the soil is still warm, without fear of competition from weed seeds.

Irrigated land may be freed from weeds by watering which will germinate these, and a cultivation to destroy the weeds after their germination.

Fertilisers.—Phosphatic fertilisers are essential and, on fertile ground containing a good supply of humus or organic manure, 2 cwts. of superphosphate are recommended. Where the pasture mixture contains permanent grasses, however, and there is some doubt as to the fertility of the soil, a fertiliser containing superphosphate 5 parts to 1 part nitrogen is recommended, such as superphosphate and ammonia No. 2 at the rate of 2 cwts. per acre.

Depth of Seeding.—Pasture seeds should not be sown at a greater depth than ¾ of an inch, or less than ¼ of an inch. If the land is moist to the surface, broadcasting may be practised, followed by a light rolling. A guide in depth of sowing is that "seeds should not be sown deeper than a distance equal to four times their diameter."

Method of Seeding.—Drilling is preferred, and has the advantage of giving a better and more even germination. The seed may be mixed with the fertiliser, but mixing should not take place until it is desired to sow.

Should the seed bed be firm, broadcasting the seed and fertiliser, followed by a light brush harrowing, has given good results.

Time of Seeding.—Autumn planting is the general rule. Spring planting is only recommended where sufficient moisture is present to ensure germination, or irrigation water is available.

Quality of Seed.—A great deal of attention has been paid in recent months to the differences found between strains of the same species of pasture plants. Where possible, seeds should be purchased carrying a certificate from some reputable authority, preferably a Government institution, setting out the strain, percentage of germination, freedom from disease and weed seeds. Should the seed purchased be of a low germinating capacity or a non-persistent strain, the total outlay of preparation may be wasted, or, worse still, a direct injury ensue from the harmful nature of weeds introduced.

Rate of Seeding.—The rate of application of pasture seeds per acre varies considerably from district to district, owing to the large area of the State deemed suitable for the growth of some species of pasture plants. The amount of seed to

be sown when endeavouring to establish pasture depends on several factors, as follows:—

1. Type of soil.
2. The variety and quality of seed.
3. The condition of the seed bed.
4. The seed mixture to be sown.
5. The climatic conditions governing the district in question.

In all instances, however, the aim in pasture production is to cover the surface of the land with an even sward of fodder as quickly as possible.

The following tables set out the rates of seeding recommended per acre under varying conditions:—

"A."—Where pure stands of any particular variety are to be sown without a cover crop.

"B."—For the sowing of pure stands of a particular variety with a cover crop.

"C."—The sowing of pasture mixtures under various conditions.

"A."—Pure stands without Cover Crop.—Table 1 sets out the rate of seeding recommended for single plant pastures in the three main districts of the State identified by rainfall:—

Table 1.

Rates of Seeding for Single Plant Pastures.

Seed.	South and South-West. 25—60in. rainfall.	Great Southern. 18—25in. rainfall.	Wheat Belt. 18in. rainfall.
	lb. per acre.	lb. per acre.	lb. per acre.
Wimmera Rye Grass	15 to 20	10 to 15	8 to 10
Italian Rye Grass	20 „ 25	15 „ 20	10 „ 12
Perennial Rye Grass	20 „ 25	15 „ 20	...
Cocksfoot	10 „ 12	...	...
Yorkshire Fog	6 „ 8	...	...
Phalaris tuberosa	6 „ 8	...	...
Timothy	4 „ 6	...	...
Subterranean Clover	4 „ 6	3 „ 4	2
Drooping Flowered Clover	4 „ 6	3 „ 4	...
Cluster Clover	...	4	3 „ 4
White Clover	4	...	...
Red Clover	6 „ 8	...	...
Lucerne	8 „ 15	5 „ 9	2 „ 3
Lotus major	4	...	...
Burr medic	8 „ 12	8 „ 10	6 „ 8
Lupins	1 „ 1½ bush.	1 bushel	½ „ 1 bush.

"B."—Pure stands with a Cover Crop.—In many districts the practice of establishing pasture in two years by the use of a cover crop is quite common. The advantage of this method is that less seed per acre of the pasture plants is required, as these plants will thicken during the second year by seeding, only annual pasture plants being generally used.

Table 2 gives the rate of seeding where such pure stands are required following a cover crop, usually a cereal:—

TABLE 2.

Seeds Sown with a Cover Crop.

Seed.	South and South-West.	Great Southern.	Wheat Belt.
	per acre.	per acre.	per acre.
Wimmera Rye Grass ... ... and Oats	5 lb. 1½ bush.	3 lb. 1 bush.	1 to 1½ lb. 1 bush.
Wimmera Rye Grass ... ... and Wheat	5 lb. 1 bush.	2 to 3 lb. 45 to 60 lb.	1 lb. 45 lb.
Subterranean Clover ... ... and Oats	2 lb. 1 to 2 bush.	1 to 1½ lb. 1 to ½ bush.	1 lb. 1 bush.
Crimson Clover ... ... and Barley	4 lb. 1 to 1½ bush.	3 to 4 lb. 1 bush.	... ...
Lupins ... ... and Wheat	... ...	6 to 10 lb. 45 to 60 lb.	2 to 4 lb. 45 lb.

"C."—Pasture Mixtures.—These are usually sown in the heavier rainfall districts of the State, and any mixture should contain tall strong-growing high fertility grasses with a proportion (approximately 40 per cent.) of legumes. The particular mixture decided upon is governed mainly by the type of soil available and the prevailing climatic conditions.

To assist in deciding upon the mixture to be sown, Table 3 sets out the various types of soil commonly met with in the South-West portion of the State on which it is desired to establish permanent pasture.

TABLE 3.

Soil Types for the Sowing of Pastures in the South-West.

A.—Well-drained undulating country omitting gravel hills, *i.e.*—
(1) with over 40 inches rainfall, *i.e.*, Denmark, Manjimup, Margaret River;
(2) with 30-40 inches rainfall, *i.e.*, Donnybrook, Bridgetown.

B.—Coastal plain type: Clay loam to a heavy clay carrying red gum, flooded gum, generally requires draining, *i.e.*, Benger, Cookernup, etc.

C.—Summer moist land excluding drained peaty swamp, including certain portions of Napier Creek country.

D.—Drained peaty swamps.

E.—Sandy to sandy loam waterlogged in winter, often carrying peppermint, stunted jarrah, etc., *i.e.*, low country around Busselton.

F.—Same as "E," but with clay subsoil, *i.e.*, 4-8 inches.

G.—Dry, more or less gravelly ridges.

Mixtures Recommended.—The various mixtures recommended under different conditions, and for the various types of soil indicated in Table 3 above, are concisely grouped in Table 4 according to whether the land to be sown is—

(a) Virgin land.
(b) Old cultivated non-irrigable land ("dry").
(c) Irrigated land.

In sowing these pasture mixtures, particular attention should be paid to the fertility of the soil and reference made to a paragraph on "fertilisers" earlier in this article.

TABLE 4.

Seed Mixtures for Various Soil Types—Pounds per Acre.

Seed Mixture No.	Soil Type.	Time to Sow.	Perennial Rye grass.	Italian Rye-grass.	Wimmera Rye-grass.	Cocksfoot	Paspalum.	Phalaris tuberosa.	Kikuyu or Water Couch Roots.	Alsike Clover.	Subterranean Clover.	Drooping Flowered Clover.	Red Clover.	White Clover.	Wild White Clover.	Cluster Clover.	Lotus Major.	Total Weight of Seeds in Mixture.
A.—VIRGIN LAND—																		
1	A1	Autumn ...	...	10	...	...	...	...	...	...	4	...	...	1	½	...	...	15½ lbs.
2	A2	do. ...	...	10	...	...	...	...	...	...	4	...	...	...	...	...	...	14 ,,
3	B	do. ...	...	10	or 10	...	...	...	...	...	4	1	...	...	...	...	...	15 ,,
4	C	Spring ...	...	...	...	...	12	...	...	...	...	...	2	½	½	...	1	16 ,,
5	D	Autumn ...	...	...	...	...	12	...	3ft. apart ...	...	...	...	...	½	½	...	1	14 ,,
6	E	do. ...	...	...	...	...	...	...	...	...	...	4	...	...	...	...	...	4 ,,
7	F	do. ...	...	...	...	...	...	...	...	...	2	2	...	...	...	...	...	4 ,,
B.—OLD CULTIVATED DRY LAND—																		
8	A1	Autumn ...	12	7	...	5	...	...	...	...	...	...	2	1	½	...	...	27½ ,,
9	A1	do. ...	7	...	...	...	10	...	...	...	...	...	...	1	½	...	2	18½ ,,
10	A1	do. ...	...	...	...	...	...	5	...	...	...	...	...	1	½	...	...	6½ ,,
11	A2	do. ...	...	...	...	...	...	5	...	...	...	...	...	1	½	...	...	6½ ,,
12	A2	do. ...	12	7	...	2	...	...	...	...	2	...	...	1	...	...	...	19 ,,
13	C	do. ...	5	...	...	...	12	...	...	...	...	...	3	1	½	...	1	22½ ,,
14	G	do. ...	...	...	10	...	...	...	...	...	...	...	...	...	...	3	...	13 ,,
C.—IRRIGATED LAND—																		
15	Soil heavy ...	Autumn-Spring	14	5	...	4	...	...	...	1½	...	...	3½	1	½	...	...	29½ lbs.
16	Soil medium	do. ...	14	3	...	4	...	...	...	1	...	...	2	1	½	...	...	25½ ,,
17	do. ...	do. ...	7	...	...	...	10	...	Kikuyu (3 ft. apart)	...	...	...	...	½	½	...	...	18 ,,
18	Soil light ...	do. ...	16	3	...	3	...	...	...	½	1	...	2	1	½	...	1	28 ,,
19	General ...	do. ...	10	3	...	3	...	...	Kikuyu (3 ft. apart)	1	1	...	2	1	½	...	...	21½ ,,

THE PRESERVATIVE TREATMENT OF FENCE POSTS.

(With Particular Reference to Western Australia.)

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SUMMARY.

1. The utilization as fence posts of timbers at present destroyed in clearing farm lands and removed during the forestry practice of thinning is discussed.

2. The main causes of timber deterioration such as decay, damage by termites and borers, and the reasons for differences in the durability of different woods are given in a simple form.

3. The principles of wood preservation, including preservatives of value for fence-post preservation and the different methods for treatment, are outlined.

4. The construction of a simple farm-treating plant and methods of preparing solutions and treating posts are described in detail.

5. Schedules of treatment times for nine species of Western Australian timbers, using both oil and water-soluble preservatives, are given.

6. An estimated cost of treating posts and a discussion of the economy of treatment, together with a suitable method and examples of determining the latter, are presented.

1. INTRODUCTION.

From the earliest days of farming in Western Australia, the raspberry jam or jam post (*Acacia acuminata*) was recognized as the ideal timber for fencing purposes, and it was used in preference to all others. No reliable estimate of its life can be given, but fences constructed 50 and 60 years ago are still in perfect condition and a life of 50 years is believed to be a conservative estimate. Jam, however, generally grows on good wheat land. In addition to an increase in farming areas in the jam country, which is largely restricted to the localities adjoining the Great Southern Railway and the Midland Railway, the so-called Eastern wheat belt has been developed. This country carries little, if any, jam, the common species of timber being gimlet, salmon gum, boree, morrell, etc. None of these timbers is durable, and jam posts have been used whenever possible. Supplies of jam, however, are becoming scarcer and will become more so in the future. As well as an increased price due to increased demand and reduced supply, the Eastern wheat-belt farmer has to add the cost of freight from the source of supply and the cost of cartage from the railway. As a result of freight charges jam fence posts have been reported to be costing from £4 10s. to £7 10s. per 100 at the siding. At Narrogin and Wickepin the same posts have been quoted at £3 per 100 on siding.

In the clearing of farm lands the present practice is to destroy the greater part of the standing non-durable timber. Yet at very little extra cost fence posts could be cut from this material.

In certain districts, the Forests Department and private companies are growing crops of timbers, in the management of which thinning at definite periods is entailed. These thinnings, in the early development of the forests, would be ideal for fence posts if they could be rendered durable. Moreover, in the case of mallet in the Narrogin district, the forest produce, tannin bark, is ready for stripping when the trees are 5in. to 6in. diameter breast high.

The main purpose of this pamphlet is to show how the farmer can utilize his own stocks of timbers for fence posts by treating them with preservatives. It also indicates the possibility of the farmer purchasing untreated thinnings and subsequently treating them on his farm, or of the large scale treatment of thinnings by Government Departments and private companies for retailing to farmers as treated fence posts.

A knowledge of the fundamental causes of timber deterioration and the principles of wood preservation are desirable for a better understanding of the methods outlined later, and a short account of these subjects is therefore presented before dealing with the practical treatment of the fence posts.

2. CAUSES OF DETERIORATION OF TIMBER.

The main causes of timber deterioration are decay (rot), termites (white ants), other insects, mechanical failure, and fire. Various other causes, such as stock, floods, etc., are not of great importance.

FIG. 1.—Photograph of a highly-magnified piece of wood, showing fungus threads (the small thread-like lines running in all directions in the light-coloured bands) and holes (the smaller irregular-shaped holes, also in the lighter bands) in the wood caused by the fungus.

Decay.—Decay is often called dry rot, wet rot, doze or dote. These are not different forms of decay, and are all caused by the action of fungi which are low forms of plant life. The common mushroom, for instance, is a typical fungus.

When developed, the portion of the mushroom above the ground consists of a stalk to which is attached an umbrella-shaped, fleshy portion which is called the fruiting body. Below ground the stalk quickly disappears. If a careful search is made, however, thin white threads can be seen running out in all directions from the portion of the stalk in the ground. These white threads are somewhat similar to the roots of ordinary plants, and they extract nutriment for the growth of the mushroom from decaying vegetable matter in the soil. An extensive plant system is already developed before the mushroom appears, and this enables the very rapid growth of the edible portion. Wood-destroying fungi, however, instead of living in the ground, live in the timber, and consist mostly of fine threads which penetrate the wood in all directions, and actually absorb certain portions of it. (See Fig. 1.) As these substances are absorbed, the normal structure of the wood is broken down until it becomes soft and friable, *i.e.*, typically rotten.

At times these fine threads grow together to form thick white or pale-coloured sheets generally of a leathery texture. Sometimes, also, the threads grow out to the surface or into a large crack to form masses known as fruiting bodies. These fruiting bodies may be shaped like mushrooms or like brackets (see Fig. 2), or

FIG. 2.—Fruiting bodies of a wood-destroying fungus.

may be quite irregular. They produce millions of small spores (similar in purpose to the seeds of ordinary plants), which, because of their minute size, are easily transported long distances by wind. An example of the number and the size of the spores is given by the common puff ball, which is a fungus. If a ripe puff ball is broken open, a fine powder like a brown smoke spreads everywhere. This powder actually consists of millions of spores. In the case of the wood-destroying fungi each spore, if it lodges on a piece of timber and the conditions are satisfactory, can germinate and set up decay.

Decay can also be conveyed to sound wood by placing it against decayed wood or by allowing small pieces of the fungus threads to come in contact with it. In other words, rot is contagious.

For fungi to develop it is necessary that certain conditions of moisture, air, and heat shall be present, together with a suitable food. The moisture required varies somewhat for different species of fungi, but it has been found that excessive moisture on the one hand or a minimum of moisture on the other will prevent growth and hence decay. Thus, wood which is waterlogged, submerged under water, or buried in continually soaked soil, will not decay; while timber which is kept continually dry will also remain free from decay. Fungi need very little air, and it is not possible under ordinary conditions of timber usage to prevent their growth by stopping their air supply. In a fence post, suitable conditions for fungus growth generally exist at the ground line. Here the moisture content of the timber is often that most satisfactory for rapid decay, and the air supply is unrestricted. The range of temperature for the growth of fungi varies somewhat, and at very high and very low temperatures growth is prevented and the fungus may even be killed. However, the weather is not always too hot or too cold, so that there are times when the temperature conditions are conducive to fungus development. Wood is the suitable food, and as the moisture, temperature, and air supply cannot be controlled in fence posts, the most practical means of combating the decay fungi is by introducing into the wood preservative materials which are poisonous to them. (See page 194.)

Fig. 3.—A typical termite mound.

Photograph kindly supplied by Mr. G. F. Hill.]

Termites (*White Ants*).—Termites, popularly known as "white ants," are not true ants from the scientist's view-point. Like true ants, however, they live a social life, and in each colony there is a definite division of labour, different work being performed by various forms or castes. Some species of termites build mounds in which the colony lives, and which are very common throughout Australia. (See Fig. 3.) If a piece is broken off a termite mound so as to expose

the interior, at least two different forms or castes will always be seen. These are the worker and the soldier.

The workers (see Fig. 4) are soft-bodied, white to greyish coloured, blind, and sterile. It is this caste which causes the damage to timber structures by eating and destroying the wood. Workers also build the mounds and communication tunnels, feed the soldiers, the king and the queen, and the young of the colony.

The soldiers usually are of darker colour than the workers, are blind, have larger brownish-coloured heads, and have jaws especially shaped for defence from attacks by other insects. (See Fig. 4.) In one common group of termites the head is extended into a long snout and the jaws are undeveloped. From the end of

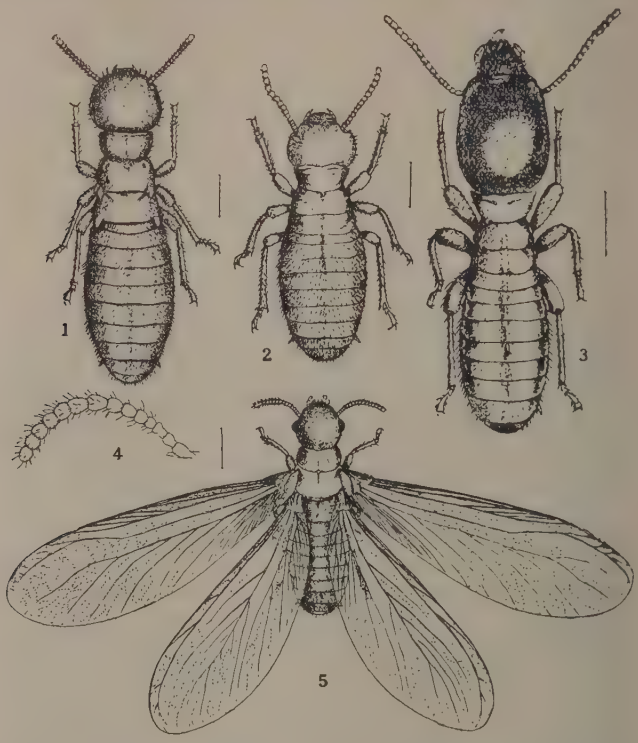

FIG. 4.—Different forms or castes of termites: 1. Immature form of winged termite. 2. Worker. 3. Soldier. 4. Antenna of the winged form. 5. Winged form. (Note.—The lines alongside each caste represents the actual size.)

Illustration from Froggatt: "Forest Insects and Timber Borers."]

the snout the soldier can eject a poison to repel other insects. The defence of the colony is the main duty of the soldiers, and it is not unusual to see them prepared to repel intruders by lining all cracks or other openings made in the mound.

Generally, in spring or autumn, long, slender, winged forms, popularly called "flying ants," may be found in the colony. They are very ant-like in character, but, unlike the worker and soldier, can see. These are the young reproductive

forms, and are either male or female. At certain periods in the year they may be seen flying from the parent colony in large numbers. If a pair of these flying forms escapes the attacks of other insects and birds and finds a suitable location, it will settle down and form a new colony.

If we break a mound open completely, we may be fortunate in laying bare the royal chamber where live the king and the queen. These are the parents of the colony, and were originally two flying forms. The queen grows to a large size and usually remains in the royal chamber, where she produces enormous numbers of eggs, which are removed by the workers to nearby chambers to hatch into young termites. When first hatched these young termites are called larvae, and are all superficially alike. Later they develop either into workers, into soldiers, or into winged forms. Some termites have the power, if the queen should die or is becoming less prolific in laying eggs, to cause certain of the older larvae to develop into further queens and, if necessary, kings. In some species of termites which do not build mounds there are no true workers as described above, the work of this caste being performed by larvae and immature stages of the winged form.

The food of termites varies, and they have been reported as living on wood, cellulose, cotton, paper, leather, grass, sugar, horn, bone, seeds, etc.

According to their nesting habits, termites may be broadly grouped into two classes, namely, subterranean and tree dwellers. The subterranean dwellers live in the soil, and often construct mounds on the ground. The tree dwellers never live in the soil or in mounds, and are generally found in galleries tunnelled in growing or dead trees. Both groups are found in Australia, the greater damage to timber structures being done by members of the subterranean group. The discussion which follows refers principally to this group, although some of the information may apply to the tree dwellers.

Termites of the subterranean group need a constant supply of moisture for their successful development and, therefore, must have a constant contact with the earth. Because of this habit it is possible to trace the entry of the termites to infested timber above ground. The termites always conceal themselves in the wood, in the ground, or in their communication or shelter tubes. To reach timber not in contact with the ground, they may enter through cracks in cement floors or brickwork (as in a house), through heart pipes or cracks in wooden-house foundation blocks, or else they may build their covered runways over any convenient surface. (See Fig. 5.) Damage above ground level may, therefore, be prevented by insuring that no access cracks, etc., are present, by periodically breaking down any runways that may be formed over the surfaces, and by suitable treatment of the surrounding soil. Special termite insulators can also be used to prevent the building of runways over exposed surfaces.

Infestation of sound timber can occur by two main methods. A termite colony which might be in the vicinity may extend its galleries to the sound timber and attack it, or the sound timber may form a suitable place for the development of a new colony by the flying reproductive forms.

Damage by termites can cause large losses of timber, and prevention of this is sometimes difficult. In the case of fence posts the only practical method is by the use of durable woods or preservative treatment in which the non-durable wood is rendered immune from attack.

Borers.—The main types of borers likely to cause damage to hardwood fence posts are the powder post borer and the auger borer. The greater part of the damage to the timber is done below the surface by the undeveloped beetle or grub form. This grub form develops into the beetle, which immediately commences to bore its way out of the wood to the surface. Where it emerges, small round holes can be seen. Generally, the attack is confined to the sapwood only, especially in the

case of the powder post borer. The auger borer, however, may extend its attack to the truewood* (or heartwood) of the post.

Softwood or pine posts may be attacked by a species similar to the so-called furniture borers. This borer will attack both the sapwood and the truewood (heartwood).

The extent of damage to fence posts by borers is thought to be small and no evidence has been obtained of posts having to be replaced because of their damage. Prevention of attack would be possible by completely treating the post with preservatives as detailed later, but the expense does not seem to be justified as a safeguard against borers alone.

FIG. 5.—Termite communication tubes on concrete pile.

Photograph kindly supplied by Mr. G. F. Hill.]

Miscellaneous Causes.—Effective fireproofing of fence posts is not economically practicable, and no precautions can be taken against floods, lightning, etc. Mechanical failure may be due to using fence posts of too small a diameter and can be corrected by increasing the size or by using a stronger species.

3. DURABILITY OF AUSTRALIAN TIMBERS.

The durability of timber from different species of trees varies widely. One species, such as jam, will be very durable, whereas another such as mallet will be non-durable. The results of chemical and laboratory tests on durable and non-

* The term "truewood" has been adopted to describe what is usually termed heartwood. In Australia, the central portion of a tree is very often affected by decay or has little strength. This portion, which is really part of the heartwood, is called "heart." The terms "heart" and "heartwood" are therefore confusing, and that portion of the tree between the "heart," or the pith, and the sapwood has been named the truewood.

durable timbers have shown that the durable timbers contain substances which are poisonous to fungi, whereas the non-durable ones have a much less quantity of such substances or none at all. In some cases the poisonous material is an oil; in others it is probably a solid material.

Sapwood and Truewood.—The sapwood or outer part of a tree, which is usually of a lighter colour than the truewood, is chemically different from the truewood in that it does not contain substances which are poisonous to fungi or termites. As a result, sapwood does not resist decay or insect attack. A common practice in Australia is to remove the sapwood from poles and posts at and near the ground line. This practice undoubtedly prevents the more rapid attack of truewood, but it also considerably reduces the effective diameter of a pole or post, and, as the sapwood and truewood have for these practical purposes the same strength, it would be desirable to retain the sapwood. Sapwood generally is much more easily treated with preservatives and, as will be shown later, it is particularly desirable to retain it on treated posts or poles.

Conditions of Growth.—Fast-grown, young timber is frequently less durable than slow-grown, mature timber. This difference is important in the use of untreated timber, but, with effective preservative treatment, a fast rate of growth may even become an advantage, provided the younger, fast-grown material does not "pop" or split excessively either before or after treatment. Young, fast-grown material has usually a wider sapwood and a more easily penetrated structure.

Influence of Locality.—It is a popular belief that timber should be used in the locality in which it was grown in order to obtain the maximum life possible. In some cases, evidence tends to show that this is correct, but there are other factors which are much more important. The chief of these is the possibility of infection by organisms of decay or by insects being greater in one district than in another. This is shown in Western Australia. In the South-West, and in areas with an annual rainfall of more than 15 inches, the main cause of renewal of timbers is decay. In the Eastern wheat belt, and farther East and North where the rainfall is less than 15 inches annually, the decay of timber is less, but the severity and frequency of termite attack increases.

Soils, too, have an influence on durability. For instance, in soils which are continually wet the water-logged condition of the post at the ground line reduces the possibility of decay. The experience of farmers in Western Australia tends to show that in some localities there is less attack by termites on typical sandy soils than there is on those of a loamy nature. Decay can also be expected to be less serious in well-drained sandy soils.

Time of Cutting.—Contrary to the popular belief that trees should be cut only when the sap is down, the time of cutting has no effect on the durability, provided that proper care of the posts is subsequently taken. Actually there is no such state as the sap being "up" or "down" throughout a tree. Numerous tests have shown that the amount of sap in a tree trunk does not vary from winter to summer, and as a result there is no advantage to be gained in more rapid seasoning, etc. On the other hand, the influence of the seasons of the year on the rate of drying is an important factor. Very rapid drying of fence posts, especially those cut from young trees, causes an excessive number of cracks and splits. In the drier parts of Australia, felling in the winter is thus an advantage, provided the posts are immediately stacked properly. If the posts are cut in the winter, drying is not so rapid, but by the summer a large amount of drying will already have taken place. At the end of the seasoning period such posts will have less splits and cracks than those cut and stacked the same way in the summer.

4. PRINCIPLES OF WOOD PRESERVATION.

As has been stated, the development and growth of fungi require certain conditions of air, moisture, and temperature, and a suitable food. Obviously, control of the supply of air, moisture, or temperature is not possible for fence posts. The only factor that can be controlled is the food, namely, the wood. Insects, too, require certain conditions of air, moisture, and temperature, and control of their food is generally the only possible practical method. Certain woods are durable because of the presence of poisonous substances. If, therefore, materials which are poisonous to decay and insects are placed into non-durable woods they will be converted into durable ones. Wood preservation treatments are designed to introduce materials which will render the wood poisonous, and thus prevent the growth of fungi or insects. It is not necessary to penetrate the wood completely with preservatives, but only to provide a continuous outer layer of impregnated wood. In some cases this layer should cover all surfaces of the treated timber; in others (as in most cases of fence posts) it is only necessary to treat that portion to be placed in the ground and just above the ground line.

5. PRESERVATIVES.

There are large numbers of preservatives which have been, or are being, advocated for use. They may be broadly divided into two groups, namely, oil preservatives and water-soluble preservatives. Only those of particular value and interest for the preservation of fence posts in Australia at the present time will be discussed.

(*a*) *Oil Preservatives.*

Coal-tar creosote is an oil prepared from coal-tar. The results of extensive tests and of experience in other countries have shown that this oil is the most effective for general purposes. It is, however, dark coloured, and has a distinct odour, both of which may in some cases be undesirable. Creosote oil varies considerably in quality, but any good grade oil will give good results, provided there is sufficient of it introduced, and that the penetration of the oil into the wood is satisfactory (see Appendix 1).

Tar is often used for brushing or painting the ends of posts, etc., but it is of very doubtful value. It is much less poisonous to fungi and insects than is creosote and its penetration into the wood is less than with creosote used under the same conditions. Its use is not recommended.

Petroleum Oils.—These are not sufficiently poisonous enough to fungi to prevent decay, and their use for prevention of insect attack cannot at present be recommended.

Creosote and Oil Mixtures.—Where the cost of creosote is high, it is an economy to dilute it with a petroleum oil. Naturally, pure creosote is more satisfactory, but creosote, if of a good grade, is generally sufficiently poisonous to withstand some dilution with non-poisonous oils. The use of the crude oil lowers the cost of the preservative or for the same expense provides a better distribution of the creosote in the wood. The best oil for dilution is crude petroleum, or a light fuel oil which may be added to form a solution consisting of *2 parts of creosote to 1 part of oil.* The treatment schedules given in Table I. Schedule of Treatment were obtained by using this mixture.

Patented or Proprietary Oil Preservatives.—There are a number of these available; some are good and some are of doubtful value. They are usually more expensive than ordinary creosote and any one proposing to use them should make thorough inquiries, and if possible ask for advice from the Division of Forest Products.

(b) Water-Soluble Preservatives.

The principal water-soluble preservatives available for use in Australia at present are sodium fluoride, zinc chloride, and white arsenic (arsenic).

Sodium fluoride is a white powder which is soluble in water, about 4 lb. of it dissolving in 10 gallons of water at ordinary temperatures. It is very poisonous to fungi, but not to termites. The use of white arsenic, in addition to the sodium fluoride, is therefore necessary.

Zinc chloride is sold in a solid form or in a heavy concentrated solution containing about 50 per cent. zinc chloride. It is very soluble in water. Like sodium fluoride, it is very poisonous to fungi, but not to termites.

White arsenic (also sold commercially under the name "arsenic") is a whitish powder which is slightly soluble in water, about 2 lb. of it dissolving in 10 gallons of water at ordinary temperatures. It is not easily dissolved in water unless the solution is boiled vigorously, because the white powder floats to the surface and is difficult to wet. Experience over a large number of years has shown that white arsenic is a very effective poison against termites. Where both fungi and termites are likely to attack the timber, a solution containing white arsenic with either sodium fluoride or zinc chloride is recommended. In the drier localities, it is possible that treatment with white arsenic alone would be effective, and experiments are now being made to test this belief.

Patented or Proprietary Water-soluble Preservatives are available sometimes in powder form and sometimes in solution. Usually, the actual composition of these preservatives is not given, and as their value varies considerably, any one proposing to use them should fully investigate their efficacy first.

6. METHODS OF TREATING TIMBERS.

The objective in the treatment of timber is to introduce the preservatives into the wood so that a deep layer of preserved wood and a sufficient quantity of preservative to prevent decay and termite attack is obtained. The following methods are generally used:—

Pressure Processes.—These methods involve the use of a large specially constructed preservation plant. The timber to be treated is loaded on special trucks and is run into long steel cylinders which are then closed. Depending on the actual process to be used, the timber is first subjected to a vacuum or to air pressure, the cylinder is then filled with solution, and pressure is applied until the wood absorbs the required amount of solution. A final vacuum treatment is then often given. Where facilities are available this is the most satisfactory method for treating wood. It is not at present in use in Australia.

Open Tank Process.—For use on the farm with its natural limitations, the open tank process is the most satisfactory and practicable. The timber to be treated is placed in a tank of hot preservative and heated therein for some hours. During this heating period the air which is present in the cells of the wood is heated. It thus expands, and some of it is in consequence expelled. At the end of the heating period, the timber is either quickly removed to a separate tank containing cold preservative or else it is left to cool down in the same tank. During this cooling period, the remaining hot air in the cells cools and contracts, and the preservative is sucked in.

Generally, for the treatment of fence posts, only that portion of the post inserted into the ground, plus a further 6 inches to show above the ground, is inserted into the preservative.

Only seasoned or dry timber can be satisfactorily treated by this method. Except for timber which is very easily treated, there is practically no absorption of preservative during the heating period. All absorption takes place during the cooling or cold bath treatment. If too much preservative is being absorbed by the wood, the duration of the cooling treatment can be shortened. By increasing the length of time of the heating period, it is possible, up to a certain limit, to increase the penetration of the preservative. Full details and times of treatment are given in Tables I. and II.

Steeping Process.—This is used with water solutions only, and consists of soaking the dry wood in the cold solution, preferably for some weeks. On account of the long time required for treatment, and the fact that good penetration and absorption of the preservatives are not usually obtained, its general use cannot be recommended.

Dipping Process.—This consists of placing the seasoned fence posts in the hot preservative solution for a short period—generally five to fifteen minutes. Very little penetration and absorption of preservative into the wood occurs, although all surfaces and cracks are generally well coated with the preservative. Only oil preservatives should be used with this process. With water solutions, the thin coating so obtained is easily washed off by rain, and so their use is not advocated. As the preserved layer of wood is very thin, and the amount of preservative absorbed very small, long life cannot be expected from timber so treated. The treatment probably justifies the expense, and is advantageous in that large numbers of posts can be quickly treated at a relatively small cost.

Brushing Processes.—These consist of brushing, painting, or swabbing the preservative into the timber. Only oil preservatives are satisfactory for this purpose, and they should be brushed on hot, preferably at about 200 deg. F. Every care should be taken to ensure that the oil is forced into all cracks or defects in the wood. Several coatings should be applied, each coating being allowed to dry before the next is commenced. The use of hot oil allows the cracks, etc., to be more easily treated. The method is not as satisfactory as dipping, and good results should not be expected from its use. It is cheap, and large numbers of posts can be quickly treated with a minimum of preservative. Only well-seasoned wood should be used, because, with green timber, further cracks will occur on drying, and these will immediately expose untreated wood. Fence posts should be painted in order to coat the portion being placed in the ground, together with a further 6 inches above the ground.

Brush treatments are of value for those parts of a construction which cannot be treated by other means; for recoating treated portions which have been cut into for erection purposes; or for coating contact points where decay is likely to occur.

7. ABSORPTIONS AND PENETRATIONS NECESSARY FOR EFFECTIVE TREATMENT.

The effectiveness of any preservative treatment depends upon having a continuous, unbroken, outer layer of preserved wood containing a sufficient quantity of preservative to prevent fungal and insect attack. Experiments in the preservation of Australian timbers for fence posts have shown that the penetration in the true-wood of split posts is very small—generally less than ¼ of an inch. The sapwood is more easily treated, and by the open tank process complete, or almost complete, penetration can be obtained. With all the Western Australian species except gimlet, the sapwood is usually ½ of an inch, or more, in thickness, and

this can be effectively treated. In gimlet, the sapwood is generally less, but it takes treatment fairly well. A depth of ½ an inch of unbroken treated wood is regarded as a very satisfactory protection.

The necessary amount of preservative varies with the preservative and the type of attack expected. Using a mixture of 2 parts of creosote to 1 part of fuel oil a 4-in. butt diameter fence post, if treated to a height of 2 ft. 6 in. from the butt, should absorb about 1½ lb., a 5-in. post about 2 lb., and 6-in. post about 2¼ lb., of preservative. This quantity is equivalent to 7 lb. of creosote and oil mixture per cubic foot of wood which is treated, *i.e.*, per cubic foot of post for 2 ft. 6in. from the butt. Experience in other countries has shown that with zinc chloride and sodium fluoride, about ½ lb. of dry salt is needed per cubic foot of wood in order to prevent decay. In Australia, about ¼ lb. of white arsenic per cubic foot has been found effective against termites. Using solutions containing 3½ per cent. sodium fluoride or 3½ per cent. zinc chloride together with 2 per cent. white arsenic, a 4-in. butt diameter fence post should absorb about 3 lb., a 5-in. post about 4 lb., and a 6-in. post about 4½ lb. of solution (1 gallon of solution weighs about 10 lbs.). This is equivalent to about 14 lb. of solution per cubic foot of wood. With water solutions, on account of the possibility of their being washed out by water, it is advisable to treat the timber so that it absorbs as much solution as possible.

(*To be continued.*)

FIELD EXPERIMENTS WITH WHEAT AND OATS, 1931.

SALMON GUMS EXPERIMENT FARM.

I. THOMAS, Superintendent of Wheat Farms, and L. G. SEINOR, Farm Manager.

The following are the monthly rainfalls as recorded at the farm during 1931, together with the averages for the six years this farm has been established.

	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May	June.	July.	Aug.	Sept.	Oct.	Total.			
1931	...	179	2	74	246	232	175	408	81	163	1,305	98	11	1,669
Average, six years	27	59	169	94	152	131	145	207	80	100	816	50	63	1,277

Good rains were experienced towards the end of February and presented a good opportunity for working fallowed land. Rain which fell about the middle of April germinated weed seeds and facilitated the control of weed growth.

The subsequent rainfall was ideal for wheat crops. Very severe frosts were recorded during the growing period, and these retarded crop growth. Late frosts, up to the 12th of October, also caused some damage.

The land on which the experiments set out below were conducted was of a reddish colour, originally timbered with teatree, silver bark, mallee, and light mallee. It had been cropped twice previously, in 1927 without being fallowed, when only a light yield was obtained, and in 1929 after fallow.

During June and early July, 1930, it was ploughed to a depth of 3 to 4 inches with a disc implement. This was followed by a springtyne cultivation in early October and again immediately prior to seeding.

Time of Seeding Experiment.

The object of this experiment is to determine the most suitable time for planting the wheat crop.

Two varieties were used, the midseason variety, Nabawa, being sown in mid-April, May and June, and the early variety, Gluyas Early, in mid-May, June and July.

The tables of results are hereunder:—

TIME OF PLANTING EXPERIMENT.

Variety—Nabawa. Seed—45lb. per acre. Superphosphate—112lb. per acre.

Time of Planting.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1928-31.	Percentage Yields, 1928-31.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
April 9th	17 20	17 4	14 32	14 32	12 24	15 10	105	14 28	106
May 9th	17 28	14 8	13 44	15 4	11 52	14 27	100	13 37	100
June 12th	10 40	10 16	9 52	8 40	9 36	9 49	68	8 13	60

TIME OF PLANTING EXPERIMENT.

Variety—Gluyas Early. Seed—45lb. per acre. Superphosphate—112lb. per acre.

Time of Planting.	Computed Yields per Acre.					Average Yields per acre 1931.	Percentage Yields, 1931.	Average Yields per acre, 1928-31.	Percentage Yields, 1928-31.
	Sec. 1	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
June 14th	10 0	10 0	9 4	8 40	9 12	9 23	94	11 28	79
May 14th	10 32	10 40	10 0	9 4	9 52	10 2	100	14 36	100
July 20th	9 36	8 32	6 56	6 16	6 48	7 38	77	9 3	62

This experiment again demonstrates that the yields of both early and mid-season varieties are considerably reduced when the crop is planted later than the month of May.

The seeding calendar for the Esperance wheat area, in which this farm is located, is as follows:—

Variety.	Maturity.	NORTHERN.	CENTRAL.	SOUTHERN.
		Beete, Kumarl, Dowak and Salmon Gums.	Circle Valley, Red Lake and Grass Patch.	Treslove, Scaddan.
Yandilla King ...	Late ...	... ...	April 1st to 15th ...	April 1st to 21st
Nabawa	Midseason ...	April 15th to May 7th	April 15th to May 7th	April 21st to May 21st
Gluyas Early ...	Early ...	May 1st to May 21st	May 1st to May 21st	May 10th to 31st
Noongaar ...	Very Early...	May 21st to 31st ...	May 21st to 31st	

Time of Application of Superphosphate Experiment.

This experiment was conducted to determine whether, when applying heavy dressings of superphosphate, it would be profitable to apply part or all of the fertiliser when cultivating the fallowed land in late summer or early autumn, thus allowing seeding operations to be expedited.

The tablulated results for 1931, together with the averages for the previous years, are as follows:—

TIME OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 28th May, 1931. Variety—Nabawa. Seed—45lb. per acre.

Time of application of Superphosphate.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1928-31.	Percentage Yields, 1928-31.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
75lb. in April; 150lb. at seeding	16 0	14 0	13 4	12 32	13 28	13 49	115	14 40	110
225lb. in April ...	10 32	12 24	11 20	11 44	13 44	11 56	100	13 19	100
150lb. in April; 75lb. at seeding	15 52	12 48	13 36	13 20	13 4	13 44	114	14 6	106

The average results for the four years that the experiment has been conducted show that the yields are decreased when a portion of the fertiliser is not applied at seeding time.

Rate of Application of Superphosphate Experiment.

This experiment was divided into two sections in order to test the effects of applying the following amounts of superphosphate to the wheat crop—

Section 1—300 lb. per acre.
150 lb. per acre (Control).
225 lb. per acre.

Section 2—No superphosphate.
150 lb. per acre (Control).
225 lb. per acre.

The following tables show the results obtained:—

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 9th May, 1931. Variety—Nabawa. Seed—45lbs. per acre.

Rate of application of Superphosphate per acre.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1929-31.	Percentage Yields, 1929-31.
	Sec. 1	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
No super.	6 0	10 40	8 8	8 48	7 44	8 16	54	7 9	48
150lb.	14 40	17 12	15 12	15 28	15 44	15 39	100	15 2	100
75lbs.	17 12	15 4	14 24	15 52	15 44	15 39	100	14 14	95

RATE OF APPLICATION OF SUPERPHOSPHATE EXPERIMENT.

Planted on 4th May, 1931. Variety—Nabawa. Seed—45lb. per acre.

Rate of application of Superphosphate per acre.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1929-31.	Percentage Yields, 1929-31.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
300lb.	16 8	17 20	18 16	19 20	18 48	17 58	102	15 30	105
150lb.	16 0	18 40	17 20	17 52	17 52	17 33	100	14 48	100
225lb.	17 44	17 20	18 48	17 44	17 12	17 46	101	15 33	105

These results indicate that the yields are increased when heavier rates of superphosphate are applied.

Under present economic conditions, however, the rate of 112 lb. per acre appears to be the most economical.

Nitrogen Experiment.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of a nitrogenous fertiliser are applied to the wheat crop in addition to superphosphate.

For the purpose of the experiment two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwts. per acre respectively, the applications in each case being at planting time.

Superphosphate was applied to all plots at the rate of 112 lb. per acre, and those plots which received superphosphate only were treated as controls.

The experiment was conducted on both fallowed and unfallowed land, the results being shown hereunder:—

NITROGEN EXPERIMENT.

NON-FALLOW SECTION.

Planted on 8th May, 1931. Variety—Nabawa. Seed—45lb. per acre. Superphosphate—112 lb. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1930-31.	Percentage Yields, 1930-31.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
112lb.	8 40	7 28	9 44	11 28	11 28	9 46	97	10 54	96
Nil	10 40	10 0	10 32	9 20	9 52	10 5	100	11 23	100
224lb.	9 44	10 32	10 0	10 32	9 44	10 6	100	11 13	99

FALLOW SECTION.

Planted on 8th May, 1931. Variety—Nabawa. Seed—45 lb. per acre. Superphosphate—112 lb. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Percentage Yields, 1929-31
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.			
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	%
112 lb.	14 0	14 16	10 24	10 32	11 12	12 5	106	98
Nil	10 56	13 28	10 32	11 44	10 32	11 26	100	100
224 lb.	13 12	11 36	11 12	10 8	10 56	11 25	100	93

These results do not indicate any increase in yield from applying a nitrogenous fertiliser to either fallowed or unfallowed land.

Manganese Experiment.

The object of this experiment is to determine whether any increase in yield is obtained by applying, in addition to superphosphate, a manganese fertiliser to the wheat crop at planting time.

Manganese sulphate was applied as follows:—

Plot No. 1—28 lb. manganese sulphate.

Plot No. 2—Nil (control).

Plot No. 3—56 lb. manganese sulphate.

Superphosphate was applied to all plots at the rate of 112 lb. per acre.

The following results were obtained:—

MANGANESE EXPERIMENT.

Planted on 18th May, 1931. Variety—Gluyas Early. Seed—45 lb. per acre. Superphosphate—112 lb. per acre.

Quantity of Manganese Sulphate per acre.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%
28 lb.	14 0	13 20	11 52	12 16	12 56	12 53	95
Nil (Control)	13 44	13 12	12 56	13 28	14 16	13 31	100
56 lb.	13 36	11 28	12 56	10 56	13 28	12 29	92

These results are similar to those obtained at the other experiment farms and indicate that no substantial increase in yield was obtained by the application of a manganese fertiliser to the wheat crop.

Depth of Ploughing Experiment.

The object of this experiment, which has been conducted for the past three years, is to determine the most economical depth to plough for the wheat crop.

Three plots, each repeated five times, were required, one ploughed to a depth of 2 inches, one to 4 inches, and one to 6 inches.

The plots were all ploughed the previous June with a disc plough, springtyne cultivated in early October, and again immediately prior to seeding.

The results are shown hereunder:—

DEPTH OF PLOUGHING EXPERIMENT.

Planted on 8th May, 1931. Variety—Nabawa. Seed—45 lb. per acre. Superphosphate—112 lb. per acre.

Depth of Ploughing.	Computed Yields per Acre.				Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1929–31.	Percentage Yields, 1929–31.
	Section 1.	Section 2.	Section 3.	Section 4.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
2in. deep	11 4	10 40	11 20	10 40	10 56	101	11 48	93
4in. deep	11 12	10 0	11 36	10 40	10 52	100	12 38	100
6in. deep	11 52	9 12	11 52	10 0	10 44	99	12 14	97

Both this year's results and the average results for the past three years indicate that there is no advantage to be gained by ploughing to a depth greater than 4 inches.

Time of Ploughing Experiment.

The object of this experiment is to ascertain whether the time of carrying out the initial operation of fallowing, *i.e.*, ploughing, has any effect upon the yields of the resultant wheat crop.

Three plots, treated in the following manner, were required:—

Plot 1—Ploughed in March, 1930 (long summer fallow).
Plot 2—Ploughed in June, 1930 (early winter fallow).
Plot 3—Ploughed in September, 1930 (late winter fallow).

The March plots were ploughed when the land was very dry in spite of a good rain which had fallen during the previous month.

The June plots were ploughed when the land was in excellent condition for that operation, while the condition of the ploughing for the September plots was fair.

The results obtained from the respective plots are shown below:—

TIME OF PLOUGHING EXPERIMENT.

Planted on 8th May, 1931. Variety—Nabawa. Seed—45lb. per acre. Superphosphate—112 lb. per acre.

Time of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields 1931.	Average Yields per acre, 1928-31.	Percentage Yields, 1928–31.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Mid March	11 52	10 0	10 0	10 0	8 40	10 6	78	11 54	91
Mid June	14 24	13 4	13 20	10 40	13 12	12 56	100	13 2	100
Mid September ...	10 56	10 8	9 44	8 16	8 33	9 31	74	11 27	88

The results obtained this year, and the average results for the past four years, indicate that better results are obtained when the land is ploughed during the early winter months. Thus ploughing should be commenced immediately after seeding has been completed.

EXPERIMENTS ON "KOPI" SOILS.

Owing to the unsatisfactory crops of wheat generally obtained from the so-called "Kopi" soil in the Salmon Gums area, it was decided to conduct experiments with a view to obtaining definite information regarding crop response on this class of soil.

The Salmon Gums "Kopi" is described as a light-grey, highly calcareous soil. It is fairly powdery and resembles grey morrel soil of the Eastern Wheat Belt. With working, "Kopi" soil tends to compact down a little.

The vegetation includes giant mallee timber, this being a variety of Eucalyptus oleosa and is a member of the red morrel family.

The following experiments were conducted:—

Seasonal planting trial with wheat.
Seasonal planting trial with oats.
Fodder trial.
Manurial trial.

The land on which these experiments were conducted was disc ploughed to a depth of 3 inches during the previous June and springtyne cultivated during early October.

It was then harrowed after rain in December, and again in February and immediately prior to seeding.

Seasonal Planting Trial—Wheat.

The object of this trial is to determine the most suitable time to plant the very early, early, and midseason maturing varieties of wheat.

Accordingly the standard varieties Noongaar, Gluyas Early, and Nabawa were each planted in their respective plots during the months of April and May.

The results obtained are shown hereunder:—

SEASONAL PLANTING EXPERIMENT—WHEAT.

April Planting.

Planted on 17th April, 1931. Superphosphate—112 lb. per acre. Seed—45 lb. per acre.

Variety.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%
Noongaar	8 0	6 24	6 24	5 52	5 36	6 27	96
Nabawa	8 48	8 16	6 40	5 36	4 16	6 43	100
Gluyas Early	10 8	7 44	6 24	4 48	3 12	6 27	96

SEASONAL PLANTING EXPERIMENT—WHEAT.

May Planting.

Planted on 16th May, 1931. Superphosphate—112 lb. per acre. Seed—45 lb. per acre.

Variety.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%
Noongaar	6 40	5 4	4 0	4 32	3 44	4 48	95
Nabawa	7 44	5 52	4 16	4 0	3 28	5 4	100
Gluyas Early	5 4	6 24	4 16	3 28	4 32	4 47	95

These results, although for one year only, indicate the advantage of the early planting of wheat on this class of soil, even though the varieties may vary in the time of maturity. Very little difference in yield is indicated between the varieties.

Seasonal Planting Trial—Oats.

The object of this experiment is to determine the most suitable month to plant the early, midseason, and late maturing varieties of oats on this type of soil.

Accordingly the standard varieties Mulga, Guyra, and Algerian were each planted in their respective plots during the months of April and May.

The results obtained are shown hereunder:—

SEASONAL PLANTING EXPERIMENT—OATS.

April Planting.

Planted on 15th April, 1931. Superphosphate—112 lb. per acre. Seed—40 lb. per acre.

Variety.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%
Mulga	21 24	17 24	23 24	26 16	24 16	22 29	85
Algerian	25 8	25 8	26 32	24 32	32 0	26 32	100
Guyra	28 16	25 24	27 8	24 32	30 0	27 8	101

SEASONAL PLANTING EXPERIMENT—OATS.

May Planting.

Planted on 18th May, 1931. Superphosphate—112 lb. per acre. Seed—40 lb. per acre.

Variety.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields. 1931.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%
Mulga	32 32	26 32	26 0	26 0	25 24	27 18	119
Algerian	26 32	24 16	24 16	19 8	20 0	22 38	100
Guyra	23 8	25 8	25 24	26 0	24 0	24 32	108

These results are for one year only, and therefore not conclusive. They indicate, however, that a suitable early variety planted in May yields as well as a later maturing variety planted in April.

Fodder Trial.

The object of this trial is to ascertain the relative yields obtained from the common fodder plants when planted on this type of soil.

The yields of the green fodders were ascertained by taking cuttings from quadrats of one square yard in area systematically through the respective plots. The yields are shown hereunder:—

FODDER TRIAL.

Planted on 2nd May, 1931. Superphosphate—112 lb. per acre.

Fodder.	Rate of Seed per acre.	Computed Yield per Acre—Green Fodder.			Average Yields per acre, 1931.	Percentage Yields. 1931.
		Section 1.	Section 2.	Section 3.		
	lb.	tons.	tons.	tons.	tons.	%
Noongaar Wheat ...	45	2·313	2·570	3·084	2·656	51
Mulga Oats	40	5·140	5·269	5·140	5·183	100
Cape Barley	60	4·626	5·564	4·112	4·797	93
Rye	40	4·369	4·626	4·369	4·455	86
Wimmera Rye Grass ...	4 "	5·911	6·168	6·939	6·339	122
Veldt Grass	4	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*

These results show that the highest yields of green fodder were obtained from the Wimmera rye grass. However, its growth in the early stages was slow, but it remained green longer than the others. It is therefore of most value as a late green feed.

For early feed, however, Mulga oats, barley and rye gave satisfactory results, and indicate their suitability for early green fodder. Of the three, Mulga oats gave the highest yield. The results from the wheat do not compare favourably with the oats, barley or rye.

The germination of the Veldt grass was so poor that comparative results could not be obtained.

Manurial Trial.

Unfortunately mice caused considerable damage by interfering both with the grain after planting and the young plants immediately after germination. This occurred on some plots more than others. In consequence, therefore, it has been decided that it would be inadvisable to use the results for comparative purposes. These results, therefore, have been discarded.

FIELD EXPERIMENTS WITH WHEAT AND OATS, 1931.

MERREDIN EXPERIMENT FARM.

I. Thomas, Superintendent of Wheat Farms.
J. H. Langfield, Farm Manager.

In addition to the experiments published in the March issue of this Journal, the following experiments were conducted at the Merredin Experiment Farm during 1931:—

Fallow and non-fallow.
Time of ploughing.

The total rainfall for the year was 1,225 points, of which 912 points fell during the growing period (May to October). The following table shows the monthly rainfall, together with the average over a period of 20 years:—

—	Jan.	Feb.	Mar.	April	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1931.	...	54	4	191	218	115	197	257	81	44	912	24	40	1,225
Average 20 years ...	52	56	119	85	135	191	189	145	92	73	825	43	54	1,284

The rainfall records indicate a fairly satisfactory season, good rains being recorded from April until the end of August. This, however, was largely offset by the very cold conditions during the winter months, heavy frosts being experienced during June, July, and August. Twenty frosts were recorded during June, the late frosts being less frequent. These cold conditions during these three months of the growing period greatly retarded crop growth, even the early maturing varieties making very slow growth.

Frosts also caused considerable damage to all varieties which came into ear during the early part of September. The disease "Takeall" also badly affected all crops sown in April.

Altogether, the season was not very favourable; disease was prevalent, while winter conditions were too severe to permit the usual vigorous crop growth.

The land on which these experiments were conducted originally carried salmon gum and gimlet timber, the soil being typical of such country. For some years the three-year rotation, namely, fallow, crops (chiefly wheat and oats), and pasture, has been practised.

Fallow and Non-fallow Experiment.

The object of this experiment, which has been conducted since 1925, is to demonstrate the advantages of fallowing.

Two plots, each one-quarter of an acre in area, were set apart for the experiment, one of which was left unfallowed and the other was ploughed 4 inches deep in June, 1930. The non-fallow plot was ploughed after rain in early April. Both the plots were then springtyne cultivated in April and again in May and disc cultivated immediately prior to seeding.

The results obtained are as follow:—

FALLOW AND NON-FALLOW EXPERIMENT.

Planted on 28th May, 1931. Variety—Gluyas Early. Seed—45 lb. per acre. Superphosphate—112 lb. per acre.

Treatment.	Computed Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1925–31.	Percentage Yields, 1925–31.
	bus. lb.	%	bus. lb.	%
Fallow	24 40	100	21 35	100
Non-Fallow	21 40	88	16 9	75

These results show definitely that decreased wheat yields can be expected when the land has not been fallowed.

The percentage results since 1925 illustrate the advantages of fallowing for the wheat crop.

Year.	Fallowed.	Unfallowed.
	%	%
1925	100	38
1926	100	58
1927	100	87
1928	100	44
1929	100	72
1930	100	104
1931	100	88
Average ..	100	75

Time of Ploughing Experiment.

A Time of Ploughing Experiment has been conducted at this farm for the past eight years, with the object of determining the effect of early and late winter fallowing on the resultant crops grown on heavy land. In the past six years (1924-29) the experiment consisted of two plots, each half an acre in area, one representing early winter fallow, being ploughed during the first week in June, and the other, late winter fallow, ploughed the last week in August. The average results over this period are distinctly in favour of the early winter fallow.

Time of Ploughing Experiment.

Average results, 1924-1929 (six years).

Time of Ploughing.	Average Yield per acre, 1924-29.	Average Percentage Yield per acre, 1924-29.
	Bus. lbs.	%
First week in June ..	18 46	100
Last week in August ..	14 55	80

In 1930 the experiment was slightly modified, a third plot being included, the times of ploughing being respectively mid-June, mid-July, and mid-August, and the area of the plots each one-quarter of an acre. All plots were ploughed

to a uniform depth of 4 inches with a disc plough, the land being in good order when the June and July plots were ploughed, but was becoming hard when the August plots were ploughed, and hence turned up cloddy.

All the plots received the same subsequent treatment, being springtyne cultivated in spring, March and April, and were disc cultivated in May prior to seeding on 23rd May and harrowed after.

During the growing period it was noticed that the June and July ploughed plots were free from Takeall, whilst several patches of this disease were showing in the August plot. This fact has been observed in previous years.

The results obtained are as follow:—

TIME OF PLOUGHING EXPERIMENT.

Planted on 28th May, 1931. Variety—Gluyas Early. Seed—45 lb. per acre. Superphosphate—112 lb. per acre.

Time of Ploughing.	Computed Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1930–31.	Percentage Yields, 1930–31.
	bus. lb.	%	bus. lb.	%
Mid-July	22 12	95	22 30	88
Mid-June	23 20	100	25 40	100
Mid-August	17 32	75	18 54	74

The results are in conformity with the average results from the previous seven years and emphasise the advantage of early ploughing.

FIELD EXPERIMENTS WITH WHEAT, 1931.

Chapman Experiment Farm.

I. THOMAS, Superintendent of Wheat Farms.
F. L. SHIER, Farm Manager.

The following experiments, in addition to those published in the March issue of this Journal, were conducted at the Chapman Experiment Farm last year:—

Time of Ploughing.
Depth of Ploughing.
Mulching.
Fallow v. Non-Fallow.

The following table shows the monthly rainfalls as recorded at the farm during 1931, together with the averages over the past 26 years:—

		Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
						May	June.	July.	Aug.	Sept.	Oct.	Total.			
1931		...	...	12	61	459	241	486	273	200	96	1,755	125	56	2,009
Average, years	26	17	42	67	63	241	441	367	247	170	99	1,598	32	26	1,841

The rainfall during the autumn months was very light, no rain of any consequence falling until the 3rd of May. From this date up to the 16th almost con-

tinuous rains were experienced, 453 points being recorded. In consequence seeding operations were delayed during that period. However, this was followed by a dry period lasting until the 8th of June, enabling crops to be planted under ideal conditions. Good rains were experienced throughout the growing period, 1,755 points being recorded from 1st May to 31st October.

TIME OF PLOUGHING EXPERIMENT.

The object of this experiment, which has been conducted for the past three years, is to ascertain whether the time of carrying out the initial operation of fallow, i.e. ploughing, has any effect upon the yields of the resultant wheat crop.

For the purpose of the experiment, three plots were required:—

Plot 1.—Ploughed in March (long summer fallow).

Plot 2.—Ploughed in June (early winter fallow).

Plot 3.—Ploughed in August (late winter fallow).

The plots, each one-eighth of an acre in area, were repeated five times.

The variety Nabawah was sown at the rate of 60 lb. per acre, superphosphate being applied at the rate of 112 lb. per acre.

The results obtained are as hereunder:—

TIME OF PLOUGHING EXPERIMENT.

Planted on 20th May, 1931. Variety—Nabawa. Seed—60lb. per acre. Superphosphate—112lb. per acre.

Time of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1929-31.	Percentage Yields, 1929-31.
	Sec. 1	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
March, 1930	13 20	20 16	20 24	21 4	21 52	19 23	101	13 6	95
June, 1930	15 12	18 48	20 24	21 52	20 8	19 17	100	13 50	100
September, 1930 ...	20 32	20 0	21 4	20 24	18 48	20 10	105	13 26	97

The average results indicate that, although not to a great extent, the best returns are obtained from early winter fallow.

DEPTH OF PLOUGHING EXPERIMENT.

The object of this experiment, which has been conducted since 1915, is to determine the most economical depth of ploughing for wheat growing on fallowed land.

Three plots were required and were ploughed as follows:—

Plot 1.—4 inches, representing shallow ploughing.

Plot 2.—6 inches, representing medium ploughing.

Plot 3.—8 inches, representing deep ploughing.

The plots were each one-eighth of an acre in area and were repeated five times.

The land was ploughed with a mouldboard plough during June, 1930. It was springtyne cultivated during September and again immediately prior to seeding.

The results obtained are as follow:—

DEPTH OF PLOUGHING EXPERIMENT.

Planted on 20th May, 1931. Variety—Nabawa. Seed—60lb. per acre. Superphosphate—112lb. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1915-31	Percentage Yields, 1915-31.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
4in. deep	20 56	21 20	19 28	*	16 40	19 36	102	15 24	99
6in. deep	21 4	20 32	19 12	*	15 44	19 8	100	15 29	100
8in. deep	20 0	17 36	20 8	*	16 0	18 26	96	15 54	103

* Discarded owing to an error at seeding.

The average results show that the most economical depth to plough this class of country is 4in. They also show that the yields are not decreased when the land is ploughed deeper.

MULCHING EXPERIMENT.

The object of this experiment is to determine to what extent the cultivation of winter fallowed land is profitable during the spring and summer months.

The experiment has been conducted since 1914 and, as in previous years, the following system of cultivation was adopted:—

Plot 1 (well worked fallow).—Cultivated during spring, when required during summer after 25 points of rain or over and again prior to seeding, the object being to maintain a mulch throughout the fallowed period and to destroy weed growth.

Plot 2 (ordinary fallow—control).—Cultivated during spring and prior to seeding only.

Plot 3 (neglected fallow).—Cultivated prior to seeding only.

The land was ploughed four to five inches deep in July, 1930, with a mouldboard plough and the plots were cultivated as follows:—Plot 1 was cultivated in September, October, April and before seeding, i.e., four times. Plot 2 was cultivated in September and prior to seeding, and Plot 3 was cultivated before seeding only. All plots were repeated five times. The results for this year and the average results for 1930 are as follow:—

MULCHING EXPERIMENT.

Planted on 16th May, 1931. Variety—Nabawa. Seed—60lb. per acre. Superphosphate—112lb. per acre

Treatment.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1914-31.	Percentage Yields, 1914-31.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Cultivated in spring, after rains during summer and before seeding	18 24	17 36	16 40	16 0	16 8	16 58	105	14 55	107
Cultivated in spring and before seeding (Control)	17 52	17 20	16 0	14 40	14 40	16 6	100	13 54	100
Cultivated before seeding only	16 56	13 52	13 44	13 4	13 36	14 14	88	12 45	92

This year's results and the average results for the 17 years that the experiment has been conducted indicate that the most economical working of the fallow is to cultivate in spring and prior to seeding. It is pointed out, however, that where weeds are bad it is advisable to destroy them by cultivation at any time.

FALLOW AND NON-FALLOW EXPERIMENT.

The object of this experiment, which has been conducted for two years at this farm, is to ascertain the comparative effect upon the yields of the resultant wheat crop, when sown on fallowed and unfallowed land.

For the purpose of the experiment, two sets of plots are required, the fallow plots being ploughed with a mouldboard plough in July, 1930, and springtyne cultivated in September and prior to seeding, while the unfallowed plots were ploughed on 5th May, 1931, and harrowed prior to seeding, which took place on 20th May. The variety Nabawa was sown at the rate of 60lb. per acre and superphosphate applied at 112lb. per acre.

The plots in this experiment were larger than those in the other experiments, being three drill widths wide and 0.35 acre in area. The fallow plots were repeated three times and the non-fallow twice.

The results obtained are as follow:—

FALLOW *V.* NON-FALLOW EXPERIMENT.

Planted on 20th May, 1931. Variety—Nabawa. Seed—60lb. per acre. Superphosphate—112lb. per acre.

When Ploughed.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1929-31.	Percentage Yields, 1929-31
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Fallow ... ... Ploughed, June–July, 1930.	21 57	...	21 4	...	21 54	21 39	100	12 34	100
Non-Fallow ... ... Ploughed, May, 1931	...	16 0	...	17 7	...	16 34	77	10 50	86

Both in this year's results and the average results for the three years the experiment has been conducted, the fallowed plots show to advantage.

FIELD EXPERIMENTS WITH WHEAT, 1931.

DAMPAWAH EXPERIMENT FARM, PERENJORI.

I. Thomas, Superintendent of Wheat Farms.
F. Gishubl, Farm Manager.

The following experiments were conducted at the Dampawah Experiment Farm during 1931, in addition to those published in the March issue of this Journal:—

Fallow and Non-Fallow.
Time of Ploughing.
Depth of Ploughing.

The farm is situated 30 miles east of Perenjori, being formerly a portion of Karara Station on the fringe of the Lower Murchison.

The soil is a red friable loam, uniform in appearance, and was originally timbered with York gum, giant mallee, karara, and mulga scrub.

This is the first crop grown on this land, which was cleared during 1929 and the early part of 1930. After the burn, as would be expected, a large quantity of ashes remained on the whole area.

During the winter months (July to August) of 1930 the land was ploughed three to four inches deep with a disc cultivating plough.

Owing to the subsequent dryness of the season no further working of the fallow followed until just at seeding time. Planting was done by means of a combined cultivator drill.

The following table shows the rainfall registered at the farm since it was established:—

	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May	June.	July.	Aug.	Sept.	Oct.	Total.			
1928	*	*	*	*	164	94	238	142	71	34	743	6	156	†
1929	17	220	64	...	267	234	60	62	18	33	674	120	...	1,095
1930	...	...	93	123	48	404	160	93	22	41	768	31	54	1,069
1931	...	12	3	25	237	113	232	95	131	40	848	179	120	1,187

* No records. † Incomplete.

Only 40 points were registered up to May, and this absence of early rains was not conducive to the preparation of a good seed-bed. Heavy rains fell during the early part of May, but these were followed by a dry spell lasting well into the month of June. This caused considerable anxiety for the germinating crops. However, good rains from the end of June to early October followed the dry spell.

Severe frosts were recorded from as early as May to as late as October. The earlier frosts had the effect of retarding crop growth, but better progress was made with the advent of warmer weather in early August. Towards the end of August, however, strong, hot winds affected the crops, blackening the flag and causing considerable concern for the crops just coming into ear.

The crops planted in May appeared to be the most affected. The rain which fell during September and early October appeared to revive these crops, but the affected patches were subsequently found to have produced but little grain.

FALLOW AND NON-FALLOW EXPERIMENT.

The object of this experiment is to ascertain the effect upon the resulting wheat crop of sowing on fallowed and unfallowed land.

For the purpose of the experiment two sets of plots were required. The fallow plots were ploughed in July, 1930, and the unfallowed plots on 14th April, 1931. The plots were sown on the 6th May with a combined cultivator drill.

The plots, which were each one-eighth of an acre in area, were repeated five times.

The variety Gluyas Early was sown at the rate of 45 lb. per acre, superphosphate being applied at the rate of 90 lb. per acre.

The results are as hereunder:—

FALLOW *V.* NON-FALLOW EXPERIMENT.

Planted on 6th May, 1931. Variety—Gluyas Early. Seed—45lb. per acre. Superphsophate—90lb. per acre.

Treatment.	Computed Yields per acre.			Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1930–31.	Percentage Yields, 1930–31.
	Sec. 1.	Sec. 2.	Sec. 3.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
Fallow	8 48	8 48	9 44	9 7	100	10 22	100
Non-Fallow	8 16	7 44	7 28	7 49	86	8 57	86

The results show that the yields of the wheat crop are increased when grown on land which has been fallowed.

TIME OF PLOUGHING EXPERIMENT.

The object of this experiment is to ascertain whether the time of carrying out the initial operation of fallowing, *i.e.* ploughing, has any effect upon the yield of the resultant wheat crop.

For the purpose of the experiment, three plots were required—

Plot 1.—Ploughed in April.
Plot 2.—Ploughed in June.
Plot 3.—Ploughed in August.

All plots were repeated five times.

Subsequent to ploughing, all plots were springtyne cultivated in August and prior to seeding, which took place on 5th May. The variety Gluyas Early was sown at the rate of 45 lbs. per acre and superphosphate applied at 90 lbs. per acre.

The results obtained are as follow:—

TIME OF PLOUGHING EXPERIMENT.

Planted on 5th May, 1931. Variety—Gluyas Early. Seed—45lb. per acre. Superphosphate—90lb. per acre.

Time of Ploughing.	Computed Yields per Acre					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre, 1930-31.	Percentage Yields, 1930-31.
	Sec. 1	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
March, 1930	7 12	7 20	8 8	8 8	8 8	7 47	90	10 30	95
June, 1930	9 52	7 28	8 0	8 48	8 56	8 37	100	11 5	100
August, 1930	8 32	8 8	8 32	9 36	9 44	8 54	103	10 38	96

From this year's results and the average results, which are for two years only, it would appear that the yields are increased when the land is ploughed during the early winter months. These are in conformity with the results of somewhat similar experiments conducted at the other experiment farms.

DEPTH OF PLOUGHING EXPERIMENT.

The object of this experiment, which was conducted for the first time last season, is to determine the comparative effects upon the resultant crop of ploughing the land to different depths.

For the purpose of the experiment three plots were required, and they were ploughed in June, 1930, at the respective depths of 2in., 4in., and 6in., the whole experiment being repeated five times. The plots were planted with a combined cultivator drill on 6th May, the variety Gluyas Early being planted at the rate of 45 lbs. per acre and superphosphate applied at the rate of 90 lbs. per acre.

The results obtained were as follow:—

DEPTH OF PLOUGHING EXPERIMENT.

Planted on 6th May, 1931. Variety—Gluyas Early. Seed—45lb. per acre. Superphosphate—90lb. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1931.	Percentage Yields, 1931.	Average Yields per acre. 1930-31.	Percentage Yields, 1930-31.
	Sec. 1	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	bus. lb.	%	bus. lb.	%
2in. deep	8 40	8 48	8 8	8 48	9 36	8 48	93	10 9	93
4in. deep	9 4	9 28	10 0	9 44	8 56	9 26	100	10 52	100
6in. deep	9 28	9 12	10 8	8 56	10 48	9 42	103	10 54	100

As the experiment has been conducted for two years only, no definite conclusion can be stated, but the results agree with experiments conducted at other experiment farms and indicate that it is most economical to plough to a depth of four inches.

50-ACRE FALLOW COMPETITIONS, 1931.

Judge : G. L. THROSSELL, Agricultural Adviser.

Fallow competitions were conducted during the past season by the Bruce Rock, Merredin, Nungarin, Phillips River and Karlgarin Agricultural Societies. Judging took place during February.

The scale of points, under which the awards were made, was as follows:—

Moisture	40 points.
Condition of Mulch	10 „
Freedom from Weeds	10 „
Consolidation of Seed Bed	20 „
Uniformity of Preparation	20 „
Total	100 „

BRUCE ROCK FALLOW COMPETITION.

Seven entries were inspected in this competition, one more than the previous year, the awards being as follows:—

BRUCE ROCK AGRICULTURAL SOCIETY.

50 ACRE FALLOW COMPETITION.

Table of Awards.

Competitor.	District.	Moisture, 40 pts.	Mulch, 10 pts.	Absence of weeds, 10 pts.	Consolidation, 20 pts.	Uniformity of preparation, 20 pts.	Total, 100 pts.
Smith, C. and A. H.	Yalbarrin ...	35	9	9	19	19	91
Farrall, F. C. & Sons.	Yarding ...	36	8	9	19	18	90
Strange, P. A. (2)...	Yarding ...	37	8	9	17	18	89
Brown, S. A. ...	Bungulluping	35	8	9	19	18	89
Strange, P. A. (1)...	Yarding ...	35	7	9	19	18	88
Smith, C. & Sons ...	Yarding ...	34	7	9	18	18	86
Forster, J. C. ...	Korbel ...	33	7	8	17	17	82

The competition was won by Messrs. C. & A. H. Smith, of Yalbarrin, whose entry was awarded 91 points. The land, which originally carried salmon and gimlet, was cleared in 1917 and has subsequently been worked on a two-year rotation, namely fallow—wheat. It was ploughed at the end of June, 1931, with a mouldboard plough to a depth of 3 inches, and subsequently cultivated with a springtyne cultivator at the end of August and early September, and rigid-tyne scarified in October. This fallow was very evenly prepared, the mulch being of desirable tilth and depth, and free of weeds.

The entry of Messrs. F. C. Farrall and Sons, of Yarding, was placed second with 90 points.

The rainfall recorded from June to January, inclusive, is shown in the following table:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.				Total, June-Jan.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Total.	
Bruce Rock ...	134	216	325	675	142	44	186	16	54	70	140	1,001
Yarding (Rosedale)	129	234	302	665	117	52	169	13	51	86	150	984

The cultural details of the competitors are summarised in the following table:

CULTURAL DETAILS.

Competitor.	Original Timber.	When cleared.	Rotation.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Points.
Smith, C. & A. H. ...	Salmon and gimlet ...	1917	2 years—Fallow, Wheat	End June	Mouldboard ...	3in.	Good	Springtyne cultivated in August-September. Rigid tyne scarified in October	91
Farrall, F. C. & Sons ...	Salmon, gimlet and mallee	1917 and 1913	2 years Fallow, Wheat	June	Mouldboard and Disc	4in.	Good	Half ridgid tyne cultivated and balance disc cultivated in mid August. Springtyne cultivated in October and January	90
Strange, P. A. (2) ...	Jam, yorkgum and wattle	1911	3 years Fallow, Wheat, Oats	June	Disc	3-4in.	Good	Springtyne cultivated September	89
Brown, S. A.	Salmon, gimlet, and jam	1913	3 years—Fallow, Wheat, Oats	June	Rigid tyne scarifier	3in.	Good	Rigid tyne scarified beginning and end September	89
Strange, P. A. (1) ...	Salmon, gimlet, yorkgum and jam	1911	Fallow, Wheat, Oats, 2 years grazing	August	Disc	3-4in.	Getting hard	Disc cultivated September-October. Portion springtyne cultivated mid January after rain	88
Smith, C. & Sons ...	Salmon and gimlet ...	1917	4 years—Fallow, Wheat, Oats, Pasture	July	Disc	3in.	Good	Disc cultivated August-September	86
Forster, J. C.	Salmon and gimlet ...	1912	3 years—Fallow, Wheat, Oats	July	Mouldboard ...	4in.	Good	Rigid tyne scarified September. Harrowed end January	82

MERREDIN FALLOW COMPETITION, 1931.

For the 50-acre fallow competition conducted by the Merredin Agricultural Society there were nine competitors, an increase of one upon the previous year.

The rainfall recorded from June to January, inclusive, is shown in the table hereunder:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.				Total June–Jan.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Total.	
Merredin ...	128	253	268	649	107	68	175	42	49	72	163	987
Nukarni ...	119	193	204	516	102	72	174	62	21	53	136	826
South Walgoolan	156	246	286	688	116	47	163	34	64	79	177	1,028
Hines' Hill ...	83	127	277	487	72	69	141	48	...	49	97	725

The awards are set out in the following table:—

MERREDIN AGRICULTURAL SOCIETY.

50 ACRE FALLOW COMPETITION.

Table of Awards.

Competitor.	District.	Moisture, 40 pts.	Mulch, 10 pts.	Absence of Weeds, 10 pts.	Consolidation, 10 pts.	Uniformity of Preparation, 20 pts.	Total, 100 pts.
Flockart, I. H. ...	Belka	34	8	9	19	19	89
Emmett, H. C. ...	Goomarin ...	35	7	9	18	19	88
Smallacombe, T. H.	Nangeenan ...	35	8	9	18	18	88
Teasdale, H. W. ...	Totadgin ...	35	8	9	18	18	88
McKenzie, P. C. ...	Hines Hill ...	35	7	8	19	18	87
Cook, W. T. ...	South Walgoolan	34	8	8	19	18	87
Zwar, A.	Nangeenan ...	35	7	9	18	17	86
Cockram, W. H. ...	Nukarni ...	32	9	9	18	18	86
Merredin Meat Co.	Merredin ...	33	7	8	18	17	83

The winner was Mr. I. H. Flockart of Belka, whose entry was awarded 89 points. Most of this fallow was ploughed with a skim mouldboard, the balance being done with a disc, during June. It was skim ploughed in August and cultivated with a combined cultivator-drill in October. Excepting that the mulch was a little shallow at the time of judging, this entry scored well.

Three competitors tied for second place, namely Messrs. H. C. Emmett, T. H. Smallacombe and H. W. Teasdale of Goomarin, Nangeenan and Totadgin respectively. These entries were each awarded 88 points.

The cultural details of the competitors are summarised in the following table:—

CULTURAL DETAILS.

Competitor.	Original timber.	When cleared.	Rotation.	When plowed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Points awarded.
Flockart, I. H.	Gimlet, salmon ...	?	2 years— Fallow, Wheat	June	Skim mouldboard and disc	3in.	Good	Skim ploughed in August. Cultivated with combined cultivator drill in October	89
Emmett, H. C.	Gimlet, jam, mallee ...	?	3 years—Fallow, Wheat, Stubble	End July	Mouldboard ...	3-4in.	Good	Tandem disced end July, springtyne cultivated September. Harrowed December and January	88
Smallacombe, T. H. ...	Salmon, gimlet ...	?	3 years—Fallow, Wheat, Stubble	July	Mouldboard and disc	4in.	Good	Disc cultivated September. Springtyne cultivated in October	88
Teasdale, H. W.	Gimlet, tea-tree, salmon	1914	3 years—Fallow, Wheat, Oats	July	Mouldboard ...	3½in.	Good	Cultivated with combined cultivator drill early September, and with bridle draught scarifier early November after rain	88
McKenzie, P. C.	Salmon, gimlet, mallee	1912	2 years—Fallow, Wheat	July	Disc	4in.	Good	Tandem disced early August. Harrowed mid August. Springtyne cultivated end August	87
Cook, W. T.	Salmon, gimlet ...	1924	2 years—Fallow, Wheat	June-July	Disc	4in.	Good	Rigid tyne cultivated in August and September	87
Zwar, A.	Mallee, gimlet, salmon, tea-tree	1913	2 years—Fallow, Wheat	July	Mouldboard ...	4in.	Boggy	Rigid tyne cultivated end September	86
Cockram, W. H.	Tea-tree, jam, mallee	1913	2 years—Fallow, Wheat	Mid-June	Disc	3-4in.	Good	Reploughed in August. Springtyne cultivated in October	86
Merredin Meat Co. ...	Salmon, gimlet ...	?	2 years—Fallow, Wheat	June	Disc	3in.	Good	Portion springtyne cultivated balance rigidtyne cultivated in August. Springtyne cultivated in January	83

KARLGARIN FALLOW COMPETITION, 1931.

The Karlgarin Agricultural Society conducted a fallow competition for the first time this year, the object being an endeavour to raise the standard of fallowing in the district. There were twelve competitors, the awards made being shown in the following table:—

KARLGARIN AGRICULTURAL SOCIETY.

50-ACRE FALLOW COMPETITION.

Table of Awards.

Competitor.	Address.	Moisture. 40 pts.	Mulch. 10 pts.	Absence of Weeds. 10 pts.	Consolidation. 20 pts.	Uniformity of Preparation. 20 pts.	Total. 100 pts.
Trestrail, Jas. ...	Karlgarin ...	32	8	9	18	18	85
Clayton, R. G. ...	Hyden Rock ...	32	8	7	18	18	83
Read, A. C. ...	Karlgarin ...	31	8	8	16	18	81
Grant, L. J. ...	Karlgarin ...	31	7	7	18	18	81
Medcalf, C. W. ...	Karlgarin ...	32	7	7	18	17	81
Biglin, E. J. & D.	Karlgarin ...	30	7	8	18	17	80
James, S.	Karlgarin ...	31	7	8	17	17	80
Poole, H.	Karlgarin ...	30	7	8	18	16	79
Linto, L.	Karlgarin ...	31	7	6	17	18	79
Atkinson & Green	Hyden Rock ...	29	7	7	17	18	78
Jones, J. T. ...	Karlgarin ...	30	7	7	17	16	77
Rae Bros.	Karlgarin ...	28	7	8	16	17	76

This competition was won by Mr. James Trestrail, whose competing area was awarded 85 points. The original timber on the land fallowed was salmon, gimlet and morrel, which was cleared in 1925. It was ploughed with a disc implement in early August to a depth of 3½ inches, and received a cultivation with a rigid-tyne cultivator early in October.

Mr. R. G. Clayton, of Hyden Rock, obtained second place with an entry which was awarded 83 points.

The rainfall recorded from June to January inclusive is as follows:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.				Total June-Jan.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Total.	
Karlgarin ...	148	195	341	684	173	31	204	?	?	?	...	...
Hyden Rock ...	150	152	293	595	165	46	211	26	24	70	120	926

The cultural details of the competitors are summarised in the table hereunder:—

CULTURAL DETAILS.

Competitor.	Original Timber.	When cleared.	Rotation.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Points awarded.
Trestrail, Jas.	Salmon, gimlet, morrel	1925	3 years—Fallow, Wheat, Stubble	Early Aug.	Disc	3½ins.	Good	Rigid tyne cultivated early October	85
Clayton, R. G. ...	Mallee, salmon, gimlet	1929	Wheat, Wheat, Fallow	August	Disc	3in.	Good	Re-ploughed September ...	83
Read, A. C.	Salmon, gimlet, morrel	1928	2 years—Fallow, Wheat	July	Disc	3 4in.	Good	... ...	81
Grant, L. J.	Salmon, gimlet, mallee	1929	2 years—Fallow, Wheat	July–Aug.	Disc	3–4in.	Good	Springtyne cultivated in August	81
Medcalf, C. W.	Gimlet, salmon, mallee	?	2 years- Fallow, Wheat	July Aug.	Disc	3 4in.	Good	Springtyne cultivated in September	81
Biglin, E. J. & D. ...	Salmon, gimlet, mallee	1930	2 years—Fallow, Wheat	End July	Rigidtyne scarifier	3in.	Good	Springtyne cultivated October	80
James, S.	Salmon, york, gimlet, mallee	1925	3 years—Fallow, Wheat, Stubble	July	Disc	3–4in.	Good	Rigidtyne scarified in September	80
Poole, H.	Salmon, Morrel, gimlet	1927	2 years—Fallow, Wheat	End June	Disc	3in.	Good	Re-ploughed August. Springtyne cultivated September and harrowed	79
Linto, L.	Morrel, salmon ...	1927	2 years—Fallow, Wheat	June–July	Disc	3in.	Good	Re-ploughed in August ...	79
Atkinson & Green ...	Salmon, gimlet, mallee	1930	... ...	July	Disc	3in.	Good	Re-ploughed in August ...	78
Jones, J. T.	Salmon, gimlet, mallee	1929	... ...	End July	Disc	3in.	Good	Re-ploughed in August ...	77
Rae Bros.	Scrub plain	1931	... ...	July	Disc	3in.	Good	... ...	76

The Karlgarin Agricultural Society is to be commended for its progressive step in inaugurating fallow competitions, and it is to be hoped that the result of this move will be an improvement in the quality of fallow prepared in the future, with the natural consequence of better average yields.

At the present time the need for improvement is very evident. The importance of ploughing the land thoroughly to an even depth of four inches, as early as possible in the fallowing period, cannot be over emphasised, although it is pointed out that, on soils of the morrel type, shallower ploughing is advocated on account of the difficulty in consolidation. Well prepared early fallow is one of the important factors in Take-all control, because the spores or seeds of this disease are induced to germinate when the infected fragments of the host plants are turned into the soil. If the fallow is kept clean and free of host plants the fungus will die.

The mulch on many of the fallows in this competition had a tendency to be too shallow, resulting in a drying out of soil moisture. It is important that a mulch of loose soil of a depth of at least 2½ inches should be maintained on the fallows over the summer months. It is preferred that the fallow should be cultivated with a tyned implement, either a springtyne or a rigid-tyne cultivator. The first working should be to the full depth of ploughing and across the original direction of the ploughing. The reason for this is to remove the irregularities of the ploughing, thus leaving as level a bottom as possible and also, because the tyned implements have a sifting or combing action, which brings the clods and larger soil particles to the surface and allows the finer particles to fall to the bottom. Should the condition of the land be such as to require other treatment in the form of disc cultivating or reploughing, the subsequent working should preferably be done with a tyned implement.

NUNGARIN FALLOW COMPETITION, 1931.

There was a considerable improvement in the number of competitors in the 50-acre Fallow Competition conducted by the Nungarin Agricultural Society, there being ten competitors, an increase of seven.

The rainfall recorded from June to January was as follows:—

Centre.	Fallowing Rains.				Spring Rains.			Summer Rains.				Total June–Jan.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Jan.	Total.	
Nungarin ...	119	184	223	526	97	93	190	57	21	73	151	867
Mukinbudin ...	82	174	133	389	112	80	192	30	25	49	104	685
Mangowine ...	151	120	152	423	123	52	175	57	69	110	236	834

The awards made are as hereunder:—

NUNGARIN AGRICULTURAL SOCIETY.

50-ACRE FALLOW COMPETITION.

Table of Awards.

Competitor.	Address.	Moisture. 40 pts.	Mulch. 10 pts.	Absence of Weeds. 10 pts.	Consolidation. 20 pts.	Uniformity of Preparation. 20 pts.	Total. 100 pts.
Jolly, H.	Nungarin ...	34	9	9	18	19	89
Jones, D.	Nungarin ...	35	8	8	18	18	87
Creagh Bros., Ltd.	Kwelkan ...	35	8	7	19	17	86
Manuel, C. J. ...	Mukinbudin ...	32	7	8	19	18	84
Williams, F. A. ...	Mangowine ...	35	7	6	19	17	84
Hoare, H. L. J. (1)	Burran Rock	32	8	9	18	17	84
Hodges, W. ...	Nungarin ...	31	7	9	18	18	83
Hoare, H. L. J. (2)	Burran Rock ...	31	8	9	17	16	81
Clamp, A. J. ...	Mukinbudin ...	30	7	8	18	17	80
Fitzpatrick, R. C. ...	Nungarin ...	30	7	8	18	17	80

The entry of Mr. H. Jolly, of Nungarin, was placed first with 89 points. The original timber on this land was salmon, gimlet, and morrel. The land was ploughed in July, 1931, to a depth of 3-4 inches. It was harrowed in August and cultivated with a combined cultivator-drill in January, after rain.

Mr. D. Jones, of Nungarin, was placed second with an entry which was awarded 87 points.

The cultural details of the competitors are summarised in the following table:—

CULTURAL DETAILS.

Competitor.	Original Timber.	When cleared.	Rotation.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Points awarded.
Jolly, H. P.	Salmon, gimlet, morrel	?	2 years—Fallow, Wheat	July	Mouldboard ...	3-4ins.	Good	Harrowed in August. Cultivated with a combined cultivator drill in January after rain	89
Jones, D.	Salmon, gimlet ...	1920	2 years—Fallow, Wheat	June	Disc	4ins.	Good	Springtyne cultivated August. Disc cultivated end September	87
Creagh Bros., Ltd. ...	Salmon, gimlet, mallee	1910	3 years—Fallow, Wheat, Stubble	August	Disc	4in.	Getting hard	Rigidtyne cultivated October	86
Manuel, C. J.	Salmon, gimlet ...	1922	2 years—Fallow, Wheat	June	Mouldboard ...	3½in.	Good	Springtyne cultivated August and September	84
Williams, F. A.	Salmon, gimlet, mallee, white gum	1924	3 years Fallow, Wheat, Oats	June	Mouldboard and disc	3-4ins.	Good	Rigidtyne cultivated end July. Portion springtyne cultivated	84
Hoare, H. L. J. (1) ...	Gimlet, salmon, morrel	1913	2 years—Fallow, Wheat	June July	Mouldboard ...	4ins.	Good	Rigidtyne cultivated early August on gimlet portion. All cultivated mid September	84
Hodges, W.	Jam	?	?	June-July	Disc	3-4ins.	Good	Re-ploughed August. Harrowed end September	83
Hoare, H. L. J. (2) ...	Morrel, tea-tree, salmon and mallee	1913 and 1928	2 years—Fallow, Wheat	June July	Mouldboard ...	4ins.	Good	Half uncultivated. Balance cultivated in late spring with a trip-tyne combined cultivator drill	81
Clamp, A. J.	Mallee, gimlet, and scrub	1930	2 years—Fallow, Crop	June July	Disc	4ins.	Good	Harrowed after ploughing. Springtyne cultivated in August and September	80

Particulars of R. C. Fitzpatrick's entry not to hand.

PHILLIPS RIVER FALLOW COMPETITION.

There were six entries in the Fallow Competition conducted by the Phillips River Agricultural Society, Ravensthorpe. The competition was judged early in December, somewhat earlier than the other fallow competitions, but advantage was taken of my visit to the district, in connection with judging crop competitions, to carry out this work.

The rainfall recorded from June to December was as follows:—

	Winter Rains.				Spring Rains.			Summer Rains.			Total June to December.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Total.	
Ravensthorpe ...	157	163	441	761	183	45	228	105	29	134	1,123
Mt. Short ...	134	124	372	630	175	38	213	77	30	107	950

The awards are shown in the following table:—

PHILLIPS RIVER AGRICULTURAL SOCIETY.

50-ACRE FALLOW COMPETITION.

Table of Awards.

Competitor.	Address.	Moisture.	Condition of Mulch.	Absence of Weeds.	Consolidation.	Uniformity of Preparation.	Total.
		40 pts.	10 pts.	10 pts.	20 pts.	20 pts.	100 pts.
Love, N. S. ...	Ravensthorpe	36	8	8	19	18	89
Barrett Bros. ...	Mt. Short ...	36	8	6	18	19	87
Campbell, J. ...	Mt. Short ...	35	8	8	18	17	86
Bebbington Bros.	Mt. Short ...	36	7	7	18	17	85
Chambers Bros. ...	Ravensthorpe...	34	8	8	17	18	85
Ware, J. H. ...	Ravensthorpe...	32	7	7	16	16	78

The fallow entered by Mr. N. S. Love, of Ravensthorpe, was awarded first place, with a total of 89 points. The land originally carried salmon and manna gum, which was cleared in 1928. It was ploughed during the end of June and early July with a mouldboard plough to a depth of four inches and subsequently was cultivated with a springtyne cultivator in October. There was a little weed growth present, which could have easily been controlled by sheep, and the mulch was not quite deep enough in places.

Messrs. Barrett Bros. were awarded second place, their entry scoring 87 points.

A very considerable improvement was noted this year in the quality of the fallow in this competition.

The cultural details are as hereunder:—

CULTURAL DETAILS.

Competitor.	Original Timber.	When cleared.	Rotation.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Points awarded.
Love, N. S.	Salmon and manna ...	1928	2 years—Fallow, Wheat	June-July	Mouldboard ...	4ins.	Good	Springtyne cultivated in October	89
Barrett Bros.	Salmon and mallee ...	1928	Wheat, Oats, Fallow	June-July	Disc	4ins.	Good	Springtyne cultivated early August and mid October	87
Campbell, J.	Jam, mallee, salmon and gimlet	?	3 years—Fallow, Wheat, Stubble	June	Mouldboard ...	3-4ins.	Good	Springtyne cultivated August and end September	86
Bebbington Bros. ...	Mort, gimlet, and mallee	1928	3 years—Fallow, Wheat, Stubble	June	Mouldboard and Disc	3½ins.	Good	Springtyne cultivated end August and again November after rain	85
Chambers Bros.	Mallee, salmon, and gimlet	?	3 years—Fallow, Wheat, Stubble	June-July	Mouldboard ...	4ins.	Good	Springtyne cultivated beginning August	85
Ware, J. H.	Mallee	1924	?	End June	Mouldboard ...	3ins.	Good	... ...	78

OAT VARIETY TRIALS IN THE SOUTH-WEST.

G. K. BARON-HAY, Superintendent of Dairying.

Oat Variety Trials have been conducted in the South-West for a number of years by officers of the Dairy Branch and were continued during 1931.

At Noggerup the experiment was conducted on the property of Mr. A. Smith, McAlinden. The results, as reported by Mr. M. Cullity, Agricultural Adviser, are as follow:—

Soil.—Light sand to sandy loam and gravelly. Ploughed for first time for this trial.

Cultivation.—Ploughed twice and harrowed twice. The seed and fertiliser were drilled in on 22nd May.

Rate of Seeding.—70 lb. per acre.

Fertiliser.—160 lb. per acre.

Subterranean clover burr was sown after the oats were drilled in, and the establishment was successful.

Yields are shown in the following table:—

Variety.	Planted.	Yield. (Average of 3 plots.)			Percentage Yield.
		cwts.	qrs.	lb.	
Algerian	May 22nd	19	1	24	100
Guyra	do. ...	16	2	22	86
Lachlan	do. ...	16	0	17	83
Burt's Early	do. ...	14	1	19	74
Mulga	do. ...	13	3	11	71

The above shows that, as a hay crop, "Algerian" is the most successful hay oat, while "Guyra" and "Lachlan" are better than "Burt's Early" and "Mulga." The two latter, however, were noted to grow rapidly in the early stages and were valuable as a source of early green feed.

The average results of 20 trials conducted throughout the South-West are shown in the following table:—

Variety.	Yield. Average—60 plots = 20 Trials.				Percentage Yield.
	tons.	cwts.	qrs.	lb.	
Algerian	2	8	3	13	100
Guyra	2	3	2	4	89
Lachlan	2	2	3	9	86
Burt's Early ...	1	14	2	0	71
Mulga	1	14	0	6	70

This indicates that for a hay crop "Algerian" has proved more suitable than other varieties, but in almost all centres the officers conducting the experiments noted that for early grazing "Burt's Early" and "Mulga" were preferable, and that the fodder provided by these varieties was more relished by stock than that of "Algerian."

REPORT ON DEPARTMENTAL EXPERIMENTAL PLOTS, PERTH.

C. A. GARDNER, Government Botanist.

G. R. W. MEADLY, B.Sc., Agricultural Adviser.

Last year a series of experiments was commenced with various fodder plants in order to test the suitability of introduced plants under local conditions, compare various strains and forms of pasture plants, particularly with regard to permanence, and also to provide examples of different species for those who are interested in seeing them under cultivation.

The ground was obtained for the experiments in September, 1930, and consists of an area of about one-sixth of an acre situated near the Government Gardens Nursery. The soil is a grey sand which becomes loose on the surface during summer. Owing to the water table being high in winter, a number of tile drains have been constructed at a depth of about two feet. The average depth of the summer water table is about 3 feet.

A general fertiliser consisting of superphosphate, sulphate of ammonia and potash in the proportion of 10—2—1 was used on all the plots.

The rainfall for the period under consideration, along with the average over 55 years, is given in the table below:—

From Jan. 1 to end of—	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apl.
Average ...	154	493	822	1,526	2,196	2,866	3,113	3,332	3,412	3,470	34	76	154	322
1931-32 ...	97	278	1,122	1,776	2,565	3,249	3,776	3,878	3,881	3,918	19	19	36	352

The following is a brief outline of observations carried out during the last season:—

RYE GRASSES.

A series of ten Rye Grasses ranging from True Perennial through Good False, Average False, and Bad False to Dominant Italian were obtained from the New Zealand Department of Agriculture. Owing to the large amount of discussion recently regarding so-called "pseudo-perennials," the manner of growth and period of survival of the above types were followed with interest. All these Rye Grasses were planted 25th-26th May.

True Perennial.—Carried over to produce good turf with fairly even growth.

Good False.—Early growth comparatively slow, but remained green and produced a fair sward.

Average False.—The two plots showed considerable variation. One (P2094) gave growth equivalent to that of the poorer of the true perennials. The other was of average growth, but only half survived and remained green.

Bad False.—In one plot a few plants survived, but the other died completely.

Dominant Italian.—Both plots showed out well early, but one died out while the other remained green to form a fair mat.

A number of other perennials were also tried. Of these the most outstanding was the New Zealand Certified (P2133), which made good growth early, carried through the summer months, and is now coming away well, giving a fine even sward.

The Maiden (Leiston Grown, P2135), and the Certified Maniotote (P2136) gave excellent early growth of a flat and even type, but, along with a sample from the Waite Research Institute (P2072), died out during the summer.

A line from America (P2138), received as Perennial Rye Grass, had the morphological features of a "pseudo-perenne" mixed with Italian, and died out early.

Two samples from Scotland (P2137), and Czecho-Slovakia (P2126), remained green over about half the plots.

The above results emphasise the importance of purchasing a good line of seed in order to obtain a satisfactory degree of permanence and growth production.

Wimmera Rye Grass.

A number of different lines were tried out and all dried off fairly early in summer. The McDougall strain (P2134) showed strong growth early and was the outstanding plot. Good natural reseeding has occurred in the majority of the plots and the young seedlings are now making excellent progress.

The Dominant Italians and Wimmeras showed out earlier than the perennials, but generally died out, while the perennials were still producing new growth.

All the plots were cut several times during the season and generally good regrowths occurred.

The Perennial Rye Grasses from New Zealand, particularly the Certified Seed, gave the best results, while the McDougall strain of Wimmera was the most outstanding of that species.

CANARY GRASSES.

On 26th May, 14 plots of *Phalaris spp.* were planted. Early in August *P. minor* was showing more growth than *P. canariensis*, which was little superior to *P. tuberosa* in this respect. The two most advanced perennials were, at this stage, P2074 and P2077 (both from the Waite Research Institute). These were of more erect habit than the remainder of the same species.

By the end of November all the *P. minor* and *P. canariensis* had reached the seeding stage and were drying rapidly, while the *P. tuberosa* plots were very green and producing flowering spikes. During the second week of December all the Canary grasses were cut. *P. minor* and *P. canariensis* showed no recovery at all and quickly died out. The perennials, however, soon showed up again and, at the end of January, were quite vigorous and of a healthy green colour.

The most outstanding plot at this stage was that derived from Victorian (Beaconsfield) Seed (P2148). This was closely followed by P2149, P2146, and P2147, which were obtained from New Zealand, U.S.A. (Harding Grass), and Victoria respectively. The four samples of *P. tuberosa* from the Waite Research Institute (P2074—P2077) were all green and showing good growth. By the end of April all the perennials were making good growth (4—6in. high), particularly those from the Waite Institute. The line received as *P. nodosa* (P2080), which is now regarded by most botanists as being *P. tuberosa*, appears to be at least a variety of that species on growth form. The leaves are narrower and the vegetative features give it a more hardy appearance. P2146 was introduced as *P. stenoptera*, but as yet no difference can be found between this and *P. tuberosa*, despite the fact that recently it has again been declared an authentic species in America.

It is interesting to note that seed introduced from South America as *P. tuberosa* was really typical *P. minor*. Although a good form of the annual species, this demonstrates the care which must be exercised when purchasing Toowoomba Canary

Grass. Besides being an annual which would probably be detrimental to a permanent pasture, the seed of *P. minor* is much cheaper than that of *P. tuberosa.*

Results so far indicate that *Phalaris tuberosa* is likely to become one of our most important perennial grasses, especially for the drier parts, particularly if more hardy strains can be derived. Experience shows that this grass must be free from much competition in the earlier stages of its establishment, either in the form of other fodder plants or weeds.

The annual species, *P. minor* and *P. canariensis,* were comparatively short-lived, the former making better initial growth and providing early feed.

RED CLOVERS.

At the beginning of June the following lines of Red Clover were planted:—

P2099—Montgomeryshire.
P2100—English Late Flowering.
P2101—American Mammoth.
P2102—Czecho-Slovakian.
P2103—Italian Mammoth.
P2104—Hungarian.
P2105—English Early.
P2141—Sutton's Late Flowering.
P2190—Baltimore Mammoth Red.

The germination in each case was good and generally the growth was of a high standard, producing a considerable amount of bulk. Throughout practically the whole of the season the outstanding plot was that of the Italian Mammoth. This showed excellent growth early, responded well after cutting, and with little doubt produced more bulk than any of the other plots.

The final cut was made on 4th February when the four best plots, viz., Italian Mammoth, English Late Flowering, Hungarian and Czecho-Slovakian were all above two feet in height.

Not one of the plots carried over the summer months, but this may have been due to the fact that the final cutting was delayed for a specific purpose. These plots will shortly be replanted and every opportunity afforded them to perennate.

WHITE CLOVERS.

The following plots of White Clover (*Trifolium repens*) were planted at the beginning of June:—

P2106—Suttons' Wild White.
P2107—English White Dutch.
P2108—English Wild White.
P2109—Kentish Wild White.
P2110—Lodi Mammoth White.
P2111—New Zealand White.
P2112—English Giant.
P2152—New Zealand Certified Wild White.

The first to show out were the English White and New Zealand White, while the New Zealand Certified Wild White gave a good germination but yellowed slightly owing to the cold.

The Wild Whites were slower in their early growth but produced an even turf of a healthy green nature.

Only two of the plots carried over the summer months, the English Wild White remaining practically dormant until the first rains and then making rapid growth. In the other surviving plot, the Kentish Wild White, only one plant remained.

These clovers received severe competition from weeds during the earlier part of their growth, and this season they will be resown under more favourable conditions.

LUCERNES.

Only two plots were planted, viz., Hunter River (P2188) and an introduced line (P2187). Both germinated well but the Hunter River was superior in every way, producing a greater bulk, recovering quicker after cutting, and being of more even growth.

MISCELLANEOUS GRASSES.

Cocksfoot (*Dactylis glomerata*).—Two lines of Cocksfoot, Welsh (P2167), and New Zealand Akaroa (P2168), were planted on 24th June. By the middle of August both plots were showing up well, but it soon became evident that the Welsh strain contained a considerable amount of Yorkshire Fog (*Holcus lanatus*). Several cuttings were made during the year and the Akaroa responded quicker than the Welsh, generally giving a more dense and vigorous type of growth.

Waipu Brown Top (*Agrostis tenuis*—P2166).—This grass was planted on 24th June and gave an excellent germination, producing a fine even mat. During the summer, when the sand was very loose, sheep, in grazing, pulled up a number of plants and generally disturbed the plot, which carried over with difficulty.

Tall Oat Grass (*Arrhenatherum elatius*—P2118).—Planted at the end of May the Tall Oat Grass proved to be one of the most outstanding plots in the trials. By August it was making exceedingly good growth of a flat type well adapted for grazing. Several cuttings were made, the grass remaining green throughout the summer and is now producing soft dense foliage.

Red Fescue (*Festuca rubra*, var *genuina*—P2119).—This grass made only ordinary growth and appears to be most suited as a foundation grass, particularly for playing greens, as the growth is of a very fine nature.

Crested Wheat Grass (*Agropyron cristatum*—P2121).—Gave fair germination producing plants of a spreading habit, the majority of which carried over the summer and are now renewing their growth.

Pinnate Brome (*Bromus pinnatus*—P2123).—Produced fair growth, about two-thirds of the plot carrying over the summer.

Trisetum flavescens—P2132.—Made fair growth early but died out during the summer.

Pennisetum maximum.—Roots of this grass were introduced from South Africa and made rapid growth, producing plants 3—4ft. high. It appears to be very hardy, and if kept closely grazed should be a useful fodder plant. When allowed to grow freely, however, it tends to become wiry and harsh.

Woolly Finger Grass (*Digitaria eriantha*).—Although the roots obtained from South Africa appeared to be quite dead on arrival, green shoots have now been formed, and there is every indication that the grass will make satisfactory growth. Despite several other attempts to establish Woolly Finger Grass in Western Australia, this is the first time, to our knowledge, that this object has been achieved. It is a highly valued grass in South Africa, but, owing to the non-production of seed there, all dissemination is done by means of roots.

MISCELLANEOUS LEGUMINOUS PLANTS.

Scented Clover (*Trifolium suaveolens*—P2151).—Gave good germination and produced an abundance of growth during the earlier part of the season. This clover is somewhat similar in habit to Red Clover, but is an annual with less leaf surface and large hollow stems. None of the plants produced any seeds.

Sulla (*Hedysarum coronarium*—P2129).—Germinated fairly well, but did not make much growth, possibly due to a lack of the correct inoculating bacterium in the soil. The two plants which carried over the summer formed a substantial root stock and are now looking green and healthy.

Birdsfoot Trefoils (*Lotus spp.*).—Four plots, three of *L. uliginosus* (P2142—P2144) from different sources, and one of *L. corniculatus* (P2127) from France, were sown. The germination of the *L. uliginosus* generally was poor, and a considerable percentage of the plants consisted of annual species, *L. hispidus* and/or *L. angustissimus*. None of these showed up to any advantage.

On the other hand, the *L. corniculatus* germinated well and made excellent growth, particularly during the summer. A strong rooting system was formed and good re-growth made after cutting; in fact, this was probably the most outstanding summer plot in the experiments.

A number of annuals, including a Lentil (*Lens esculenta*—P2155), Cicer Pea (*Cicer arietinum*—P2156), and *Astragalus falcatus*—P2128) were also grown.

MISCELLANEOUS.

Yarrow (*Achillea millefolium*—P2113).

Sea Rib Grass (*Plantago maritima*—P2116).

Sheep's Burnet (*Poterium sanguisorba*—P2117 and P2191).

Sheep's Parsley (*Petroselinum sativum*—P2114).

All these plots germinated well and remained green right through the summer.

Plantago maritima made comparatively slow spring growth, but came away excellently during the summer and was kept closely grazed by sheep.

The Sheep's Burnet held out well till the end of January, when about half died. The remainder made good growth after the first rains and is now doing well.

The Yarrow and Sheep's Parsley both made rapid growth and produced a considerable bulk of feed. These two plots at no stage lost their healthy green colour and when grazed were well eaten back by sheep.

HINTS ON BEES AND THEIR MANAGEMENT.

H. WILLOUGHBY LANCE, Apiculturist.

Success in beekeeping depends on many factors. To be successful, a beekeeper must take to it naturally, from a love of the bees and interest in their work. He needs patience and a capacity for taking pains and working systematically. He should study the flora of his district and know when the various flowers and trees may be expected to blossom.

His hives should be strong, well-made and well-kept, The bees should be of a good race and strain, and strong in numbers.

Hives—

Box hives without frames are useless for the gathering of honey and are not allowed under Section 12 of the Bees Act, 1930. They cannot be examined and are breeding places for disease and moth.

Some men have standard frames and hives, but have neglected to put wire and foundation into the frames, and the expenditure on frames is worse than useless, as the bees have built the combs anyhow across the frames, which cannot be removed without breaking the comb. Sometimes the frames are fitted with starters or even full sheets of foundation, but owing to the hives not being level the frames do not hang plumb and the combs are built across two frames or, due to the hereditary tendency of some bees to build irregular comb, the combs are built anyhow, and the expenditure and labour are useless.

Another type of hive is the home-made one with incorrect spaces due to the ignorance or indifference of the owner to the habits and methods of bees.

In some of these hives the covers and frames are stuck so tight with propolis that they break before they can be removed, or there is so much unnecessary space, that there is extra comb which has to be broken or cut before the cover or frames can be removed. Beekeepers should remember that the natural working space of the bee is ¼ inch. If the space is less than 3/16th of an inch, the bees will fill it up, if more than 5/16th of an inch, they will probably build comb therein.

A previous issue of the Journal contained an article on "Bee Hives." This has been reprinted in leaflet form and can be obtained from the Department of Agriculture. The number is 308. It contains particulars and sketches of a home-made hive including a cover or roof which is cheap, and more serviceable than most of those seen about apiaries.

Transferring—

Many small bee-keepers without much experience find it difficult to transfer bees from box hives to frame hives, or from frame hives with a mass of cross combs to new frame hives. For their benefit, I will give hereunder particulars of how best to do this.

The transfer should take place, if possible, while there is honey coming in, but it may be done at any time provided the bees are fed plentifully after the transfer has taken place, with sugar or honey syrup. The easiest way of feeding is to obtain a press-top tin, such as is used for honey or golden syrup. Punch a dozen or two small holes in the lid and fill with the syrup.

A quilt made of ticking, sacking, or similar material should be placed over the frames and a hole cut in the centre not larger than the size of the tin. The tin of syrup may now be inverted over the hole; the bees will then suck the syrup

through the holes. An empty super or box should then be placed on top to cover the tin and the cover of the hive replaced. At least eight or 10 lbs. of syrup should be given to each hive to enable the bees to build the new comb and lay up a store for breeding.

A syrup may be made for this purpose from sugar, using 10 lbs. sugar, 5 pints water, 1 oz. vinegar, ½ oz. salt. Boil for a few minutes and feed to the bees whilst warm. To make honey syrup, dissolve about 2 parts of honey in 1 part of water. If honey is used, the bee-keeper should be quite certain that this does not come from a hive that may have disease, as honey is the principal carrier of foul brood.

To transfer bees from old box to new hive, take the box hive and place on the ground upside down so that the bottoms of the combs are exposed, place bricks or blocks of wood under one end of box to give a slope; place new hive fitted with frames and full sheets of foundation on an empty box so that front edge of floor touches the highest end of box hive; draw body of new hive forward to project over floor about 1½ inches.

Drum sides of box and give a little smoke at lowest end. Bees will then run up highest end of box on to floor of new hive. When nearly all the bees are out the combs of honey can be cut out, some of which should be fed back to the bees after they are in their new hive; the combs of brood should be tied with string into frames and put into centre of new hive.

To transfer bees from hive with cross combs.—The method adopted may be similar to that with box hives, but in this case it will be impossible to cut out the combs of brood, and tie into frames. It should therefore not be adopted unless the hive is very strong with bees and there is a good honey flow.

Another method which may be adopted with both box hives and hives with cross combs, when the above are not suitable or easy, is to place the box or old frame hive on top of a new hive fitted with frames and full sheets of foundation, making sure that the only entrance is through the new hive.

As the brood in the old hive hatches out and honey comes in, the bees will fill the empty cells with honey and force the queen down into the new hive. When upon examination it is found that the queen is in the bottom, or new hive, a queen excluder should be placed over it to prevent her again going to the top box. Four weeks later all brood in the top box will be hatched out, and it may then be removed.

The drawback with this method is the time it takes, as the queen will not be forced down until there is plenty of honey coming in.

Bees.

In all primary industries the importance of not only having the best breeds of either seed or livestock, but also of having the breed most suitable to the conditions of the district, has never been so fully realised as at the present time.

In view of this generally acknowledged fact of the importance of good blood, it is surprising to find a large number of bee-keepers who appear to be indifferent to it. In going about the country, one finds very few men who have a really first class bee: they may have a few good colonies, but they do not breed from these, nor do they purchase new pure bred queens. They let nature have its way, allowing the bees to swarm and to re-queen themselves. This method in bee-keeping, as with poultry or any other live stock, tends to the deterioration of the stock.

Selection and breeding from selection is the only way to get the best results, reduce production costs, and enable the farmer, be he bee-farmer or other, to meet competition and earn a comfortable living.

Of course this is not the only factor upon which success depends. The general method of conducting the work of the farm is most important, and then there are so many factors over which the farmer has no control, such as the weather, forest fires, etc. This, however, is a certain fact, that in a good season, with a good honey flow, any colony of bees that is fairly strong, will probably do well, even if badly neglected by the owner. But when circumstances are against the industrious bee everything depends upon the strains from which the bees have been bred. Bees from a good stock will survive and perhaps store a surplus, while the indifferent ones will go under. Practically all successful beekeepers are careful to re-queen every colony at least every two years, and some every year, or even less if the queen does not deliver the goods.

Some of them breed their own queens from their best colonies, others consider that it pays them better to concentrate on honey production and leave the queen breeding to the expert.

The Department, recognising the importance of good stock, has imported Italian queens from Italy, and Carniolans from Jugo-Slavia, and queens bred from these can be obtained from the Department of Agriculture.

It is claimed for the Carniolan that they are a longer lived bee than the Italian, that they are hardier and will work in weather that keeps the Italian at home, and that they build beautiful white comb and are quiet to handle.

A longer lived bee means a smaller proportion of brood to that of adult bees than would be the case with short-lived bees. That, again, means less food to be consumed by the nurse bees to make chyle food for the larvae. It is usually considered that the life of the average worker bee during the honey season is about six weeks. Assuming that we can obtain workers that will live eight weeks instead of six, we shall save 25 per cent. of the food required for brood raising. For instance, assume that we have a hive of 30,000 bees with our average bee. This would require the hatching of 5,000 bees per week to keep up the population of the hives or 120,000 bees in six months. With a bee living eight weeks, only 3,750 bees would require to be hatched per week, or 90,000 in six months instead of 120,000. We thus realise what an immense saving there would be in food. Leaflet No. 331, dealing with the "Carniolan Bee" can be obtained free from the Department.

Winter Stores.

Many beekeepers who read these notes, do not carefully examine their hives at the close of the summer and ascertain that they have plenty of winter stores. Any such I would advise to at once go through their hives, lifting each one to ascertain the weight, and if any are light, mark these, and then on the first warm, sunny day open them carefully, disturbing the bees as little as possible. Examine the outside combs and see how much honey there is. The amount required varies with the district. In most cases a fairly strong colony should have enough honey to fill at least two full-depth combs; a really strong colony three or four, in addition to the honey on the broodcombs. It has to be remembered that bees consume a large amount of honey when brood-rearing. Very often a few warm spring days will start brood-rearing, then a spell of inclement weather sets in and the bees use up their last reserve of stores to feed the young larvae, and cannot get any more to replace it. Also much of the young brood gets chilled and dies. Then when honey weather sets in again there is delay in breeding until there is fresh store in the larder both of honey and pollen.

If there is little or no honey, the bees should be fed at once with honey syrup or, failing this, sugar syrup. With an average thick honey, about two-parts of honey to one of water is a good proportion. See that all the honey is dissolved and mixed with the water. Give this to the bees warm. There are many good feeders on the market, particulars of which can be obtained from any catalogue of bee goods. Failing one of these, a good home-made feeder is shown in Figure 1. The box is about 6in. x 4in. x 3½in. deep, a division is placed one inch from the end, the bottom only extends to this, thus having an entrance from the bottom, one inch wide. The top of the box consists of a piece of glass which slides in from the end,

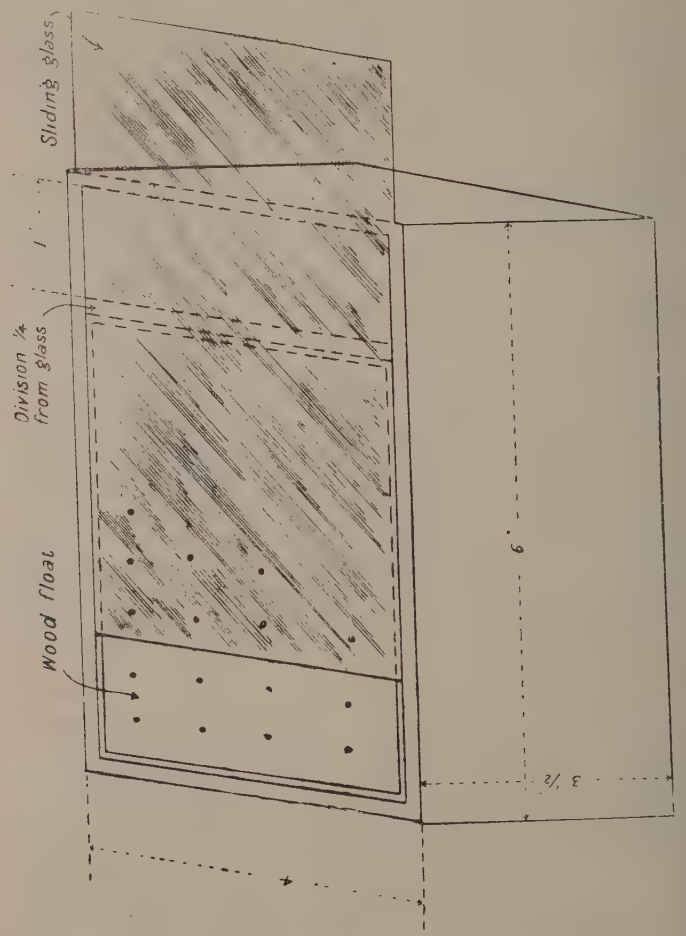

FIG. 1

a space about ¼in. must be left between the top of the wood division and the glass. A piece of thin wood is now cut about ¼in. smaller, each way, than the inside of the box, and a number of small holes bored therein. The box is filled with syrup, and a piece of wood acts as a float from which the bees feed, coming up through the inch space, extending over the division on to the float.

The advantages of this feeder are that it can be seen when it is empty, and can be refilled without removing from the hive. The inside may be filled with hot wax, swilled round and emptied out. This will make joints honey tight. If the matter is urgent and the beekeeper has not time to make the above, an effective feeder can be made by punching small holes in the top of a press-top tin, which after filling is inverted on to a plate and placed on top of the frames inside a spare super box; or a quilt from some strong material can be put over the frames, a hole cut in the centre, and the inverted tin placed over the hole. This method has the advantage that, during cold weather, the brood nest is kept warmer than with the plate method. If any colonies are weak, only covering a few frames, entrances should be closed to two or three inches.

As soon as the spring really sets in all hives should be examined, as it is a most important time for beekeepers. Hives should be cleaned and faulty ones replaced. (See notes in the *Journal* for June, 1928.) The brood nest should be examined, and if the queen is old and failing, the hive should be marked for requeening at the earliest possible date. The amount of honey stores should be noted and, if necessary, colonies should be fed. If a colony is short of pollen, make a note of it, and later a hive may be found that can spare a comb of this most important food for the young bee, as no breeding can take place without it.

Dr. E. F. Phillips, in "Beekeeping," estimates that an average strong colony of bees consumes 480 lbs. of honey per year, divided as follows:—Maintenance of bees 400 lbs., feeding of brood 70 lbs., wax production 10 lbs.

Strong Colonies.

The first object of all beekeepers should be to build up strong colonies. The aim should be two 10-frame body boxes boiling over with young bees. I still find that the aim of many beekeepers is to make a show with a large number of hives, perhaps thinking that means a lot of honey. No greater mistake can be made. A lot of hives frequently means no honey. Whereas a few strong hives mean plenty of honey and less work. This is realised to such an extent in the United States of America and England that many beekeepers are using 12-frame hives with deeper frames. At the present stage of beekeeping here, I do not recommend this, except in special cases, with experienced beekeepers, but advise every beekeeper to aim at two full-depth bodies packed with bees. Then with a good honey flow such colonies will fill two or even three honey supers. A good well-bred queen can easily keep these filled with brood during an average season. Cull your queens, and if you have any duds replace them with good stock. Who would be content with a hen that laid one egg per week when he can have one that will lay six or seven? Yet that is what many beekeepers have in the way of queens, those that lay only four or five hundred eggs per day instead of one or two thousand.

Re-Queening.

I am often asked how to re-queen, so I will give a few notes here on the matter. Of course, the first thing to do is to catch and kill the old queen, otherwise the young one will undoubtedly be killed. The usual process is to lift out the combs one by one and examine until the queen is found. It is handy to have a spare body near the hive so that the frames, as they are examined, may be placed therein; otherwise while one comb is being examined the queen may pass from an unexamined comb to one that has been examined and replaced, and thus she will be missed. If all combs have been examined and the queen not found, carefully examine the floor board and sides of the hive, then re-examine the combs as they are replaced. If she cannot be found another method may be adopted.

Remove the hive some 10 yards away in front of, and with the entrance facing, the old bee stand. Place an empty hive on old position. Now place a white sheet or piece of newspaper in front of the old hive and an entrance guard over the entrance, open the hive, take out two or three combs of brood and examine for queen. If not found, shake most of the bees on to the sheet, examine again, and if no queen, place these combs in new hive and fill up the space with empty combs on sheets of foundation. All flying bees will now return to the new queenless hive. Examine bees on sheet, and if queen is not found, take several of the remaining combs and shake bees off on to the sheet, examining bees after each shaking for the queen, then replace combs in old hive. If queen has not been found, close up the hive and leave until next day. In the meantime large numbers of bees will have sought their old stand and entered the new hive. As the number of bees in the old hive will now have been much reduced, it should not now be difficult to find the queen. This having been done, all the old combs and bees may be transferred to the new hive; or the old hive can be replaced on its old stand and the combs and bees in new hives transferred to it.

The queen having been disposed of, the usual method is to leave the hive queenless for a day, then taking the mailing cage in which the queen has been received, remove the cork or corks and also remove one frame from the hive and wedge the cage in the centre between the remaining frames. In the course of a few days the bees in the cage and those outside will have eaten away the candy and the queen bee released. By this time she will have the scent of the hive, and will be accepted.

Other methods of introduction are—

1. Smearing the queen with honey and placing her directly between the frames.
2. Wetting the queen with water and placing directly between the frames.

Both these methods depend upon the instinct of the bees to clean up the honey or water; by the time this is completed the queen and bees will have the same scent, and the queen will be accepted. Mr. Bartly, of Tasmania, claims that he has been successful with the water method in 98 per cent. of the introductions. His method is to wet the queen by placing her in a short glass tube partly filled with tepid water, shake the tube to and fro, pour off the water and allow the queen to walk down amongst the bees after giving a puff of smoke.

Yet another method which I had recommended to me, and which I have used with complete success, is the paper bag method. Take a small thin paper bag, such as is used for lollies, place the queen to be introduced therein, without any of her attendant bees, then catch half a dozen bees from the hive and place them in the bag with her. These bees should, if possible, be young and filling themselves with honey from the cells when caught. Although the queen is strange to them, they will be so busy trying to get out that they will not take any notice of her, and in the meantime they will all get the same scent. Remove one frame and place the bag in the hive between the frames, and in the course of a few hours the queen will have been released and accepted. The advantage of this method is that there is no need to leave the hive queenless for a day. I have opened a hive, destroyed the queen, and introduced a new one in a paper bag straight away with considerable success.

Whatever method is adopted, the hive should not be disturbed for about three days, after which time it should be opened to see that the queen is "O.K."

Pollen.

As has already been mentioned, apart from honey, the future generation of the hive depends upon a supply of pollen. Pollen is the reproductive substance of flowers, which is transferred from the male to the female portion of the flower or from the male flower to the female flower for the reproduction of species. Nature has provided various methods for this transfer. Amongst these are flying insects, of which bees are the principal. Pollen is the vital substance of the flower in concentrated form, is highly nitrogenous, and contains necessary vitamins. Nature is always prolific, and provides more than is necessary for reproduction purposes. Bees as they visit flower after flower carry the pollen from the anthers and fertilise the styles. In doing this they take a toll for their service, and carry some of the surplus pollen away to their hives to make food for their young larvae. When breeding is taking place the nurse bees consume honey and pollen and convert this into chyle food, which is deposited in the larvae cells.

If there is a shortage of pollen, therefore, breeding suffers, and the colonies do not build up, or may dwindle if insufficient bees are not bred to make up for wastage. The importance, therefore, of a pollen substitute has been realised by beekeepers for many years. From experiments that have been made it is evident that the question must be studied scientifically. Recently the Beekeepers' Association of Victoria approached the Commonwealth Committee of Scientific Research with a request that investigation should be made to find a pollen substitute, and this investigation has now been commenced.

The question is being studied in other places, and the following particulars of experiments at the College of Agriculture and Forestry, Brno, Czechoslovakia, will be of interest to beekeepers. As far back as 1871 Fischer propounded the theory that the pharyngeal gland was the source of the larval food. Stephen Soudek at the above College has recently been making microscopical studies of this gland, and his experiments therewith confirm Fischer's conception.

He fed very young bees, which had just emerged from the cells, with different foods and compared their action on the pharyngeal gland. He found that these glands only developed with those bees whose food had contained pollen. In cases where the food only contained honey or sugar, these glands shrunk up, proving the real importance of pollen. After this he tried many substitutes, amongst which were wheat flour, wheat bran, starch, ground beans, olive seed cake, linseed cake, peanut cake, ground fish, ground meat, etc. All of these did not bring the pharyngeal gland to development. Only in two cases did the glands become fully turgescent. These were when the young bees were fed with fresh egg albumen stirred into sugar syrup or with dried yeast. He, therefore, assumes that these substances can replace pollen, but states that many further experiments will have to be made before any pronouncement can be made.

He, however, advises beekeepers that as we know of no definite pollen substitute they should, when there is a lack of pollen, feed the bees with the fresh white of an egg stirred into sugar syrup. Pine pollen collected the previous season did not provoke any development of the gland. Bees fed on the yoke of an egg, ground meat and ground fish died in a few days. It is surprising the variety of substances bees will carry into their hive when there is a shortage of pollen. They realise the need for some such substance, and in their extremity have been known to work on wheat shorts fed to cows, fine sawdust, and even coal dust.

Old pollen that has been stored in the comb for a long time seems to lose its goodness, and bees always prefer the fresh gathered substance.

If there is old hard pollen in the hive, and yet no breeding taking place at the usual time, I would recommend the removal of this pollen by scraping down the

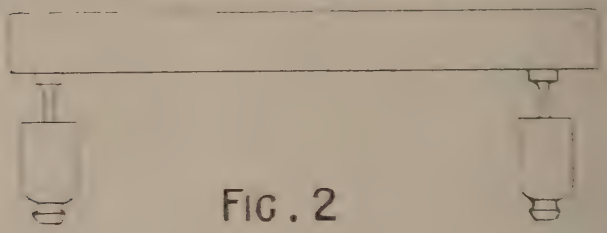

FIG. 2

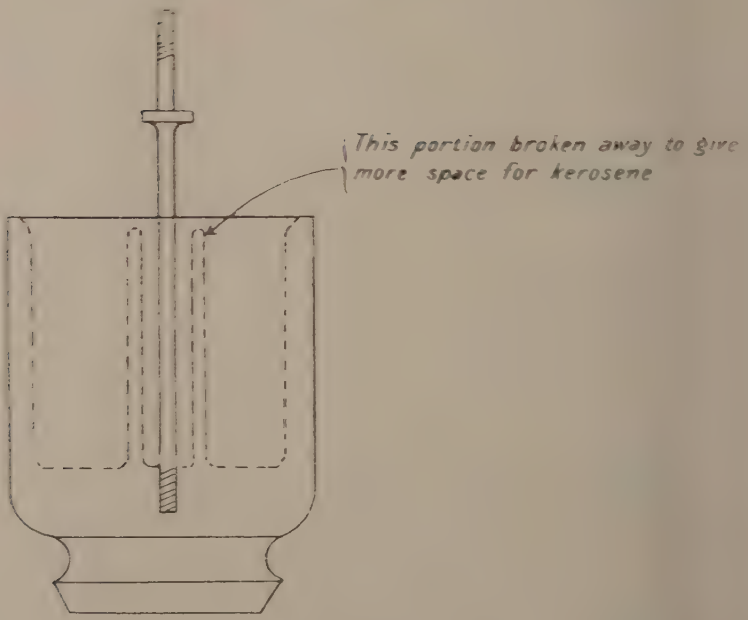

FIG. 3

Two species of ants, particularly the Meat Ant *Iridomyrmex detectus* attack the bees and cause large numbers of bees to stay home to defend the entrance.

If nests can be located, bi-sulphide of carbon, sheep dip, or cyanogas are good substances for destroying same. A hole, several inches deep, according to size of nest should be made in the centre, and a quantity of one of the above substances put therein, and the hole covered up. If the nests cannot be located or are too numerous, a good ant-proof stand may be made from old telegraph insulators, as shown in Figure 2. Four pieces of 3 x 2 inches may be nailed together to make an oblong the size of hive, and four inverted insulators let in to the corners. These should be of the hollow type, and the inside collar of china broken away (see Figure 3). This space will now form a cup, which is filled with kerosene or old motor oil from the sump.

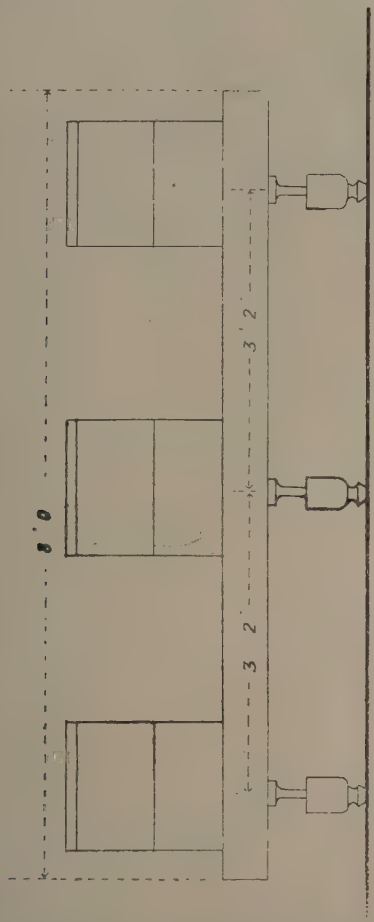

FIG. 4

If there are a large number of hives, stands to carry three hives are very convenient, and only six insulators need be used instead of 12. If the stand is made nine feet long, this will allow spaces between the hives for placing supers, etc., when manipulating. The insulator legs should be placed directly under the hives, and as these are frequently screwed on to the metal shanks, they can be screwed up or down to adjust the stand to a level. (See Figure 4.)

Moths and Foul-Brood.

Moral—do not blame the moths for all empty hives. The swarm may have got away through a native or pest queen. The hive may have been overstocked as to assist the moth and spread the pest, or Foul Brood may have been the cause of the loss of the bees.

The last cause is a very insidious and dangerous one, as it very rapidly the spread of this very infectious disease due to mistaken diagnosis.

As Foul Brood has been found in various parts of the State, it behoves all beekeepers to endeavour to correctly ascertain the cause of every empty hives. Any empty hives, with or without moth, should be carefully examined for the spores of Foul Brood in the brood combs, and if any doubt exists, a sample piece of the comb should be sent to the Department of Agriculture.

Leaflet No. 152 on "Bee Diseases" is issued free by the Department of Agriculture, and can be had upon application.

SEED SCARIFYING EXPERIMENTS WITH LOCALLY GROWN LEGUMES.

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and

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Legume seeds generally are characterised by a percentage of hard seeds, which may vary considerably from district to district and from season to season. The following table shows the figures for germination and hard seed content of a number of samples tested at the Department of Agriculture during the past nine years:

TABLE I.

Seed.	Germination.		Hard Seeds.	
	Average.	Range.	Average.	Range.
	%	%	%	%
Subterranean Clover	66·4	41·0—99·0	28·3	0·0—57·5
Lupins	19·9	6·0—45·0	58·0	28·0—86·0
Drooping Flowered Clover	26·0	0·0—49·0	72·7	37·5—96·0

It will be seen from the above figures for germination that, taking the average as a basis for calculation, the stand in the first year from Subterranean Clover may be only ⅔ Lupins ⅓, and Drooping Flowered Clover as low as ¼ of that expected. The situation is due to the high percentage—in some samples of hard seeds which may take from up to seven years or more to germinate. The reason for this lies in a surface coating, termed cuticle, as we term it in botany, which is impervious to moisture and thus prevents germination until such time as this becomes permeable. Under natural conditions weathering agencies will eventually damage portion of this coating with subsequent growth. Artificially the entrance of moisture can be accomplished by mechanical injury to the surface. Scarifying of the seed has been found to be the most practical method of accomplishing this purpose. Most machines for such work depend upon rubbing the seed against a rough inclined surface.

A new Ames Hulling and Scarifying Machine imported from U.S.A. by the Department of Agriculture depends on this principle, using garnet paper for scarifying. An illustration is shown below:—

The New Ames Hulling and Scarifying Machine.

In view of the high percentage of hard seeds encountered in most Clover samples this year, atention was drawn to the necessity for seed treatment, and experiments were accordingly conducted with this machine at the State Implement Works, Fremantle.

Lupins.—Experiments with Lupins showed that the construction of this machine is unsuitable. Feeding is through the fan, causing considerable breakage with such large seeds. The results obtained indicate that successful treatment could be obtained with small modifications of construction.

Subterranean Clover.—Results with this Clover indicate that samples which contain a high percentage of hard seeds may be treated to advantage.

Drooping Flowered Clover.—In view of the extremely low germination of this Clover and of its increasing popularity throughout the South-West portion of this State, most attention was given to its treatment. Furthermore, the machine is more adapted to scarifying seeds of this size.

Table 2 gives the results obtained with a small sample of seed procured from the Department of Agriculture:—

TABLE 2.

Treatment.	Germination.	
	Original Sample.	Scarified.
	%	%
Fan 2650 r.p.m.	0·25	40·5
Fan 2870 r.p.m.	0·25	46·75

In Table 3 are given the figures for a parcel of 1,000 lbs. treated for the Group Settlement Department. In this case the machine was working at full capacity:—

TABLE 3.

Treatment.	Germination.	
	Original Sample.	Scarified.
	%	%
Fan 2870 r.p.m.	4·0	31·0
Fan 2870 r.p.m. Scarified twice	4·0	35·0

It will be seen from Table 2 that the faster fan speed resulted in better germination. On account of the construction of the machine, it was inadvisable to make a further increase in speed. In both cases a very large increase in germination was obtained. It will be noted that scarified seed may give over 180 times the germination of that untreated, and it is evident that a reasonably satisfactory germination of at least 30 per cent. may be expected from seed so treated.

In the trials conducted it was found that the capacity of this machine is in the vicinity of 2,000 lbs. of seed per day. The whole work can be satisfactorily handled by one man.

Any farmer desiring to establish a good stand in the first year may reduce the rate of seeding of Drooping Flowered Clover by at least 4 lb. per acre by using scarified seed. This represents a direct saving of about 10s. per acre, while the cost of treatment has been estimated to be in the vicinity of 1s. per 100 lbs. of seed.

Acknowledgment is made to Mr. G. Meadly, of the Department of Agriculture, who conducted the germination tests recorded in this paper.

MINERALS IN ANIMAL NUTRITION.

J. F. FILMER, B.V.Sc., Senior Veterinary Surgeon.

Food is the raw material from which all animal products are fashioned. Such a statement may perhaps appear trite, but the writer is of the opinion that it is not sufficiently realised that it is also true. Nature, in its usual efficient manner, provided adequate food for the animals which were evolved without the aid of man. It remains for man to copy her example and provide in like manner for the animals which he has evolved from their natural ancestors. The ancestor of our 200-egg hen laid one clutch of eggs a year, and the only standard laid down for them was their ability to produce healthy chickens. The wild sheep grew only enough wool to keep itself warm, whilst our Merino is expected to annually produce enough wool to clothe a large percentage of the world's population. The race horse is expected to carry a man at a faster pace than its ancestors could gallop unburdened. The draught horse is expected to draw a load which often exceeds its own weight. The baby beef Shorthorn is required to produce 600 lbs. of beef at 18 months of age—a weight to which some of its ancestors never attained.

In nature the cow produced enough milk to rear its calf; an ordinary 600-gallon cow now produces enough milk each year to rear four calves, and a 2,000-gallon cow produces enough to rear 13 calves, while the annual yield of butter fat often exceeds the weight of the cow.

If the truth of the opening statement be realised, it will readily be conceded that the food which met all the requirements of wild animals will not suffice for the domesticated stock of to-day. The more an animal produces, whether it be eggs or energy, wool, beef or butter the greater will be the demand which it makes upon its food. Nor can these demands be satisfied by merely increasing the quantity of food, for in evolving high-producing animals man has frequently neglected to provide a capacity for an increased bulk of food. The problem which faces the animal feeder is to compress into a given bulk the whole of the constituents which are necessary not only for the growth and well being of the animal but for the formation of the animal's products which are to provide his income.

The animal body is comprised of the following constituents in approximately the proportions given:—

Oxygen	65
Carbon	18
Hydrogen	10
Nitrogen	3
Minerals	4
Total	100

Strange as it may seem the constituents which are most frequently deficient in food are those which appear in the smallest proportion in the animal body, namely, nitrogen and minerals. The number of minerals which are necessary for animal life is not definitely known, but it probably exceeds 20. Most of these are required in only very small quantities. But an absence or deficiency of any one of them may limit growth or production, may impair health, or may even cause death. If an animal's ration is deficient in any mineral, or in any other constituent, three alternatives are possible:—

1. It may eat more food and so, if its capacity is adequate, obtain sufficient of the deficient mineral.
2. It may decrease its production to the level provided for by the amount of the deficient mineral.
3. It may rob its system to provide sufficient of the deficient mineral to continue production at a level above that provided for in the ration. This process naturally cannot be continued indefinitely, and if persisted in causes impaired health and eventually death.

It is interesting to notice that neither horses, cattle, sheep or pigs were indigenous to Australia. This does not necessarily mean that Australia is not suited for the production of these animals, but it does indicate that whenever any new district is developed it may be found deficient in one or more of the minerals necessary for the profitable keeping of these animals.

The necessity for minerals depends upon three factors:—

1. Body building.
2. Body processes.
3. Production.

All animals require minerals for body processes such as digestion, the transport of oxygen and carbonic acid gas in the blood, nervous control, etc. If minerals are not present in sufficient quantity for these functions death takes place. The amount of mineral required for this purpose is small and relatively constant. It will, however, be readily seen that the amount of minerals required for body building and production must vary enormously. The quantity of minerals required by a young animal has been found to depend very largely upon its rate of growth. This will be illustrated by the mineral composition of the milk of different species, as may be seen from the following table:—

Species.	Time in which birth-weight is doubled.	Figures represent lbs. per 100 gallons of Milk.		
		Total Minerals.	Lime.	Phosphoric Acid, P_2O_5.
	days.	lbs.	lbs.	lbs.
Man	180	2·5	·49	·56
Horse	60	3·8	1·14	1·21
Cow	47	7·2	1·61	1·89
Sheep	15	8·9	2·77	2·69
Pig	14	10·3	3·95	3·33
Dog	9	10·1	3·38	3·64
Rabbit	6	25·0	...	...

It follows, then, that as we evolve more rapidly-growing cattle, sheep, pigs and poultry so must the percentage of the minerals in their rations be increased.

When production is considered we are again thrown back upon the opening sentence. Whatever the animal produces must be manufactured from its food. This is just as true of minerals as of any other food constituent. A hen laying 200 eggs uses 2¾ lbs. of carbonate of lime in making the shells. A 2-gallon cow in 10 months puts into her milk nearly 10 lbs. of lime and over 11 lbs. of phosphoric acid. This is equivalent to the phosphorus content of 50 lbs. of bone meal. It might be thought that if a dry cow is getting sufficient minerals, that when she calves it would be necessary to add to her ration only the quantity of minerals which are contained in the milk she produces. Unfortunately this is not the case. For reasons which are not altogether clear, an animal is not able to utilise the whole of the minerals which it takes in its food. The percentage which it is able to pass on in its milk varies greatly with the form in which the minerals are given. It has been estimated that an animal is seldom able to utilise more than one-third of the lime or phosphoric acid in its food for milk production. It is therefore obvious that great care must be given to ensure an adequate mineral content in the rations of all high-producing animals.

Although, as has been pointed out, some twenty minerals are found in the animal body, it is generally sufficient to consider only seven of these, viz.: Sodium, Chlorine, Calcium, Phosphorus, Iron, Sulphur, and Iodine. In the great majority of cases there is an adequate supply of the other animals, though it is extremely likely that some of the obscure diseases of animals may prove to be due to a deficiency of one or more of these rarer elements.

A short discussion of some of the functions of the above seven minerals may perhaps serve to emphasise their great importance in animal nutrition.

Sodium.—This mineral has a host of functions to perform. It takes part in a complicated "buffer" system in the blood. This ensures that the balance between acids and alkalies is constantly maintained. The upsetting of this balance in either direction causes disease. Sodium is also largely responsible for maintaining the correct saline concentration of the blood and other body fluids. It is mainly responsible for carrying the carbon dioxide from the tissues to the lungs, where it is given off in the breath.

Chlorine.—This is utilised in the formation of hydrochloric acid which is essential for the digestion of food in the stomach. It also assists in preserving the acid-alkali balance, and in combination with sodium assists in preserving the correct saline concentration of the body fluids.

Sodium and chlorine combine to form sodium chloride or common salt, and they are generally given in this form. Deficiency of salt causes indigestion, depraved appetite, and general unthriftiness.

Iron.—Iron enters into the formation of haemaglobin, which is the red colouring matter of blood. Its function is to carry oxygen from the lungs to the tissues. It apparently has other rather obscure but very important functions to perform in the body.

Deficiency of iron causes anaemia. It is interesting to note, in passing, that recent work in America has demonstrated the fact that small traces of copper are necessary, in association with iron, for the cure of anaemia.

Iodine.—This is needed in only very small quantities, but these traces are absolutely essential. It enters into the structure of the thyroid gland which has many important functions in connection with the controlling of growth and the proper utilisation of protein, calcium, and phosphorus. Deficiency causes goitre, sterility, hairlessness, and other more obscure diseases.

Sulphur.—Sulphur is an important constituent of wool. It has generally been thought that this mineral is only of value in food when given in complicated organic compounds. Recent work in South Africa has suggested that it may be of value to sheep in its more familiar form. Confirmation of this work should prove of great interest to Australian sheep owners.

Calcium.—This is the mineral which, in combination with oxygen, forms lime. It enters into the formation of bones and is an important constituent in milk. It is the main constituent of egg-shells. It has an important function in the control of nerves. Deficiency causes bone diseases, nervous symptoms, sterility, general unthriftiness, and lowered production. The rapid withdrawal of calcium from the blood has now been shown to be the cause of milk fever.

Phosphorus.—This enters into the formation of most tissues. It is one of the main constituents of bone. It is found in all cell nuceli. It is an essential ingredient of milk. It assists in the preservation of the acid-alkali balance in the blood. Deficiency causes bone diseases, unthriftiness, sterility, lowered milk production, and depraved appetite. This latter symptom, generally seen as bone chewing, results in the animal ingesting the toxin which causes toxic paralysis or botulism, which has caused such serious losses in cattle and sheep during recent years.

Sufficient has perhaps been said to emphasise the necessity for an adequate supply of minerals in the ration. We may therefore turn to the consideration of the problem of how best to supply the requisite minerals. Three principles may be laid down in regard to the sources of minerals.

1. The minerals must be present in such a form as to be available for use by the animal.

2. The materials used must be palatable, or at least they must not be unpalatable.

3. They must be sufficiently cheap to be capable of being fed economically.

In regard to grazing animals the main source of minerals, as of all other food materials, must always be pasture. Fortunately green pasture, which is properly managed, will in the great majority of cases provide all the mineral requirements of our horses, cattle and sheep, but it must be properly managed. In good pasture management, four things need careful attention.

1. Proper choice of pasture plants.
2. Proper manuring of pastures.
3. Proper grazing of pastures.
4. Proper conservation of pastures.

Choice of pasture plants and manuring of pastures lie somewhat outside the scope of this paper, but they are obviously of the greatest importance in ensuring an adequate mineral content in the food of the grazing animal.

The importance of proper grazing is not sufficiently realised. In order to obtain the best results from a nutritional view-point from pasture, it should be short, green, leafy and vigorous.

Subdivisional fencing and frequent rotation of stock from paddock to paddock materially assist towards obtaining these desired attributes.

A few figures will illustrate the importance of this.

SUBTERRANEAN CLOVER.

Date.	Length of Stem.	Phosphoric Acid (P_2O_5) in 100 lb. of dry matter.
July	3 inches	·67 lb.
October	8 inches	·64 lb.
November	9–24 inches (in flower) ...	·34 lb.
Hay	... ...	·27 lb.

GREEN OATS.

Date.	Height.	Total Minerals in 100lb. dry Matter.	Phosphoric Acid (P_2O_5) in 100 lb. dry Matter.
July	6–8 inches ...	7·84 lb.	·85 lb.
October	18 inches ...	5·97 lb.	·34 lb.
November	3ft. 6in. (in ear)	2·77 lb.	·16 lb.

The clover in July and October and the oats in July contained adequate supplies of minerals, but the rank growth of later months was very deficient in phosphoric acid.

Proper conservation of fodders should go hand in hand with proper grazing and proper manuring. In the flush period in our South-Western districts the stock are often quite unable to cope with the pasture. The conservation of silage then serves a double purpose. It not only provides a reserve of succulent fodder, but the use of the mower assists in keeping the pasture in the desirable short, leafy condition. The proper conservation of hay is also of the greatest importance. Good hay should be made from pasture which has grown rapidly. In the South-West in good seasons six to eight weeks is often sufficient. It should be cut while it is still green and leafy. It should not be exposed for long to the direct action of the sun's rays.

Numerous experiments have shown that hay prepared in this way not only contains more minerals, but that they are pound for pound of greater value to the animal. The same principles apply with equal force to the conservation of cereal hays. There is very real justification for the popular preference for chaff of a good green colour.

The whole question of pasture management is of the most vital importance, and results are already proving the value of the research work which has been, and is being carried out. At the Rowett Institute in Scotland it has been shown that properly managed green pasture will supply the whole of the requirements of a 12 cwt. cow giving four gallons of milk daily. Such a pasture is undoubtedly the best solution of all the nutritional problems that confront our dairymen, and where the rainfall is adequate, it should be their constant objective.

However, during the dry summer months, it is not possible to provide sufficient green grazing to supply the mineral requirements of our stock. It is then necessary to use supplements and the mineral constitution of some of these will be briefly considered.

All grains are fairly rich in phosphorus, but are relatively poor in other minerals. One pound of oats contains about as much phosphorus as half an ounce of bone meal.

Peas, beans and linseed are rather richer in minerals than cereal grains.

Bran is very rich in phosphorus. One pound of bran contains as much phosphorus as two ounces of bonemeal. This, in part, accounts for its great value as a fodder for dairy cows. Hay made from lucerne, clover, peas, vetches or other legumes is rich in lime.

Milk is rich in almost all minerals with the exception of iron. One gallon of skim milk contains as much phosphorus as 1½oz. of bonemeal.

Fish meal is rich in minerals and in other countries is widely used. Its economical production would be of great value to Australian stock owners.

Bonemeal is rich in both phospohorus and lime, and where it can be economically procured, is one of the best sources for these minerals.

Dicalcic phosphate is probably the most practical available source of phosphorus in Western Australia to-day. The pure chemical contains about 40 per cent. of phosphoric acid. A lick containing 18 per cent. of phosphoric acid in the form of dicalcic phosphate is now available at about half the cost of bone meal. South African experiments have shown that such a lick is probably twice as valuable as bonemeal as a source of phosphorus.

In preparing mineral supplements for farm animals, it is necessary to consider three things:—

1. The minerals which are required by the animals in question.
2. The mineral content of the foodstuffs being used.
3. This is really a subdivision of (2). Any mineral deficiency which exists in the pasture of the districts or during the season concerned.

Horses do not grow very rapidly and are not expected to produce large quantities of milk. Consequently their mineral requirements are small. Usually the provision of rock salt is all that is required.

Pigs grow extremely rapidly, and it is perhaps not generally known that a sow gives about one gallon of milk per day. Pigs are largely fed on grain which

is notoriously deficient in minerals with the exception of phosphorus. A sow, giving a gallon of milk and being fed entirely on wheat, would need to eat at least 125 lbs. a day in order to get sufficient lime. A young pig gaining 1 lb. per day would require to eat 50 lbs. of wheat per day to get sufficient lime. The phosphorus requirements of the sow could be obtained from 8 lbs. of wheat and that of the young pig from 3 lbs. of wheat.

It is apparent that pigs on grain rations are likely to suffer from lime deficiency, but with the possible exception of breeding sows, are not likely to be troubled by phosphorus deficiency. Grains are also known to be deficient in salt, in iron, and occasionally in iodine, and these minerals must be considered in compounding the pigs' ration. Milk is a splendid source of minerals for pigs. One gallon of skim milk contains as much lime as 7 lbs. of wheat. Fish meal is an excellent source of minerals and protein, and is much used in other countries at the rate of 10 per cent. of the meals fed. One pound of fish meal contains as much lime as 167 lbs. of wheat. Meat and bone meal is an excellent source of minerals and protein, but meat meal should be considered as a protein supplement only. Where fish meal and milk are not used, the following mineral supplement has given excellent results in Scotland:—

Salt	4 lbs.
Ground limestone	8 lbs.
Bonemeal	8 lbs.
Iron oxide	1 lb.
Potassium iodide	⅛ oz.

Sometimes 1 lb. of sulphur is added.

The mixture is fed at the rate of 2 to 4 lbs. to every 100 lbs. of grain. The higher rate is fed to breeding sows. On account of the high cost of bonemeal in Western Australia and the doubtful necessity for a phosphorus supplement, one is inclined to suggest its omission. The idea that a phosphorus supplement is needed by grain-fed pigs dies hard. Those who still cling to this belief could rest their souls and ease their pockets by substituting 4 lbs. dicalcic concentrate (30 per cent. P_2O_5) for 8 lbs. bonemeal, but with a possible exception in the case of brood sows, this is not considered necessary.

In America, where young pigs often become anaemic, the trouble is prevented by allowing them to root in blue grass plots. Kikuyu grass would probably prove ideal for this purpose.

The effect of feeding minerals is admirably shown in the following two experiments.

Experiment with Seven Sows.

	Average number of Pigs per litter.	Average number alive at five weeks.	Average number of Pigs at weaning.
Before feeding minerals	7	3·7	2·4
After feeding minerals—First litter ...	10·4	7·1	7·1
After feeding minerals—Second litter	9·7	8·1	8·1

A mineral supplement similar to that given above was fed at the rate of 4 lbs. per 100 lbs. of grain.

An experiment with three lots each of 20 young pigs. The ration consisted of grain and each lot had a run of 2 acres.

Average Increase of Weight per Pig per Day.

	28 days.	19 days.	20 days.	20 days.	15 days.	Whole time 102 days.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
No minerals	1·12	1·05	1·08	·95	1·34	1·09
2 per cent. minerals ...	·97	1·10	1·36	1·43	1·89	1·32
10 per cent. fish meal	1·04	1·06	1·52	1·43	1·55	1·32
Remarks	skim milk fed	No skim milk fed.				

It will be noted that where skim milk was fed, no benefit appeared to result from the addition of minerals, but immediately it was withdrawn, their benefit became readily apparent. The total average growth over the 74 days when skim milk was not fed was:—

No minerals .. .. 81 lbs.
2 per cent. mineral .. .. .. 105 lbs.
10 per cent. fish meal .. .. 102 lbs.

Both these experiments were conducted by R. G. Basket in Ireland.

Poultry are grain eaters and egg producers. They are, therefore, receiving a lime deficient ration and at the same time giving off relatively large quantities of lime in the form of egg shells. Lime is, therefore, probably the mineral which requires to be given in largest quantities. In other countries this is generally provided in the form of fish meal or bonemeal. The following have been used successfully:—

Fish meal—10 per cent. of the mash;
Bonemeal 4 parts; salt 1 part—given as 5 per cent. of the mash;

Bonemeal—100 parts;
Ground limestone—40 parts;
Salt—40 parts;
Sulphur—10 parts;
Iron oxide—10 parts;
Potassium iodide—1 part.

The mixture is given as 5 per cent. of the mash. As in pigs, one feels that the bonemeal might well be replaced by an equivalent amount of ground limestone.

Sheep and cattle on good winter grazing should not require mineral supplements. During our dry summer, however, they certainly require a phosphorus-containing supplement. The failure to provide a lick which ensures an adequate daily intake of phosphorus has this year been responsible for large mortalities amongst sheep and cattle, especially in the wheat belt areas. These losses have been due to botulism, a disease caused by germs which grow on animal debris. Bones, and particularly rabbit carcases, are very common sources of this trouble. During recent months, numbers of inquirers have stated that licks have been provided without the mortality ceasing. This is sometimes due to non-phosphatic licks being used. At other times the phosphorous content of the licks is low or the quantity of lick provided has not been sufficient.

Work at Understepoort, in South Africa, has shown that the optimum daily intake of phosphoric acid for two-tooth ewes weighing about 80 lbs. is about ⅛ ounce. For 100 sheep for a week this would be 5½ lbs. The amount of phosphoric acid which 100 sheep would obtain in one week from our summer pasture is about 3 lbs., and in parts of the wheat belt may be even less. This leaves a deficiency of 2½lbs. of phosphoric acid. This would be provided in 14 lbs. of dicalcic lick having an 18 per cent. phosphoric acid content. This should be taken as the minimum amount of lick to be provided in the wheat belt.

Oats are often fed to sheep in this State, and it is interesting to note the phosphoric acid content of this important feed. 1,000 lbs. of oats contains 8 lbs. phosphoric acid. If oats are fed at the rate of 1 lb. per day per sheep they will supply in one week to 100 sheep about 5½ lbs. phosphoric acid. This, it will be noted, is exactly the amount which the South African authorities have found to give the best results.

Oats may be highly recommended as summer feed for sheep as they supply protein as well as phosphorus, and this ingredient is also sadly lacking in our summer pastures. They also serve as an excellent medium in which to administer licks and solve the whole problem of palatability in a convenient and economical manner. The licks should be thoroughly mixed with the oats. The following are the figures for 100 sheep for one week. They should be accepted as minimum figures for the wheat belt and may, if necessary, be increased:—

No oats—14 lbs. dicalcic lick.
175 lbs. oats—11 lbs. dicalcic lick.
350 lbs. oats—8 lbs. dicalcic lick.
525 lbs. oats—4 lbs. dicalcic lick.
700 lbs. oats—no lick required.

These figures are for light weight merino sheep, and should be increased for heavy crossbred or British breeds of sheep.

Feeding of licks should commence from the time the pasture seeds and should continue until green grazing again becomes available.

For cows the quantity of lick required depends largely on the amount of milk produced. Green in South Africa has shown that bone chewing commences when the phosphorus falls to a certain level, which is expressed as a ratio between the phosphorus content and the energy produced by the ration. In order to bring the phosphorus level in our summer pasture up to the point where bone chewing ceases, it would be necessary to give a dry cow 2ozs. dicalcic lick per day. But in order to bring the phosphorus level up to that of good English hay, it would be necessary to give over 5 ozs. of dicalcic lick per day. The question of supplying minerals to milking cows during the few months in which they are dry, is of the greatest importance. It has been shown that heavy milking cows on the best possible rations will often rob their system of minerals. Their only chance to replace these is during the short interval between the periods of lactation.

Stewart, of Cambridge, has calculated that a 4-gallon cow requires just over 3.1/3 ozs. of phosphoric acid per day. Other observers have stated that 1oz. of phosphoric acid is required for every gallon of milk produced. A cow feeding on our dry summer pasture would get only 1¼ ozs. of phosphoric acid per day. Thus, for a 4-gallon cow there would be a deficiency of from 2 to 2¾ ozs. phosphoric acid per day. 13ozs. of dicalcic lick contains 2.1/3ozs. phosphoric acid.

It may therefore be stated briefly that cows confined to dry summer pasture would require the following quantities of dicalcic lick:—

	ozs.
Dry cow	5
1-gallon cow	7
2-gallon cow	9
3-gallon cow	11

2ozs. for every extra gallon of milk produced.

It is, of course, customary to feed concentrates to cows during summer. If crushed oats are fed 1oz. of lick may be deducted from the total for every 2lbs. of oats fed. Bran is very rich in phosphorus and 2ozs. of lick can be replaced by 1lb. of bran. Two examples will show how the amount of dicalcic lick required may be calculated.

For a 2-gallon cow receiving 6lbs. crushed oats—

For cow	5 ozs.
For 2 gallons milk	4 ozs.
Total	9 ozs.
Deduction for oats	3 ozs.
Quantity of lick to be fed	6 ozs.

For a 3-gallon cow receiving 5lbs. of bran—

For cow	5 ozs.
For 3 gallons milk	6 ozs.
Total	11 ozs.
Deduction for 5lbs. bran	10 ozs.
Quantity to be fed	1 oz.

On account of the salt content it is suggested that where it is necessary to use more than 4ozs. of dicalcic lick per day, that the dicalcic concentrate be used instead. 3ozs. of dicalcic concentrate is equivalent to 5ozs. dicalcic lick.

All these figures have been based on the assumption that the sheep and cows have been on rations containing sufficient phosphorus prior to commencing the feeding of lick. If animals have been on phosphorus deficient rations for any length of time, it may be necessary to greatly increase the quantities suggested.

Theiler, in South Africa, quoted cases of cows whose system was so depleted of phosphorus that it was necessary to give licks for two years befor the system recovered sufficiently for the cow to be got in calf.

The figures for oats and bran may, perhaps, have to be revised for these commodities where they are produced in phosphorus deficient districts.

The dicalcic lick referred to in this paper is compounded as follows:—

Commercial dicalcic phosphate	45
Salt	40
Molasses	5
Water	10

This contains 18 per cent. phosphoric acid (P_2O_5), of which 90 per cent. is present as dicalcic phosphate of lime. A dicalcic concentrate is available which contains 30 per cent. phosphoric acid. By mixing six parts of this with four parts of salt, the lick above given is obtained. Any lick containing 18 per cent. of phosphoric acid in the form of dicalcic phosphate may be used in the proportions quoted. Where the phosphoric acid is present as tricalcic phosphate, a larger quantity of lick would need to be used unless the lick contained more than 18 per cent. of phosphoric acid.

In conclusion, one would urge all stock owners to include in their creed the following eight principles:—

1. All stock require minerals.
2. Young rapidly growing stock require fodder that is particularly rich in minerals.
3. Minerals must be given to supply those given out in milk or eggs.
4. Young short leafy pasture is rich in minerals.
5. Summer pasture in Western Australia is almost invariably deficient in phosphorus.
6. Minerals in pasture may be increased by proper top dressing.
7. Silage and properly cured hay are richer in minerals than old dry pasture or hay that has been made too late or that has been too much exposed to the sun.
8. Minerals supplements should be prepared in a rational way to contain the minerals that are deficient in the feed and should be fed in the correct quantities.

SOME METHODS OF GRAFTING.

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To the ancients the phenomenon of grafting and budding was a very misunderstood subject. Many wild claims were made even by prominent men. Virgil speaks of a plum tree that bore apples after having been grafted. Martial advised the grafting of the cherry on the poplar. Columella in a like manner claims that the olive should be grafted on to the fig. Other extravagant claims included the following—that the orange grafted on the holly would ensure the former being acclimatised to the open woods, and that the vine grafted on to the walnut would enable the grapes to contain oil.

These wild claims, however, indicate that the art of grafting was recognised, and to some extent it must have been practised, but it is only recently that the absurdity and the idea that man was degrading Nature by such practices, have been mostly eliminated.

The scope of grafting is enormous—a fact not realised by many people. Together with budding, it is employed on nearly all our orchard trees, though to some extent walnuts, plums, and loquats are propagated by cuttings. Grape vines in the main viticultural countries also require to be grafted. One would naturally

assume that a tree on its own roots would flourish much better than when grafted on to another's. Perhaps it would, but there are other factors to be considered. The following are some of the more important:—

1. Grafting is used to perpetuate a variety of fruit. Let us take an example. The "Granny Smith" apple tree was noticed many years ago growing in New South Wales. Its qualities were outstanding. Since then many thousands of trees have been derived from it. The seeds very rarely come true to type, and in the early stages of propagation, cuttings would be a more wasteful way of perpetuation.

The navel orange furnishes another excellent example of the perpetuation of a variety. The navel orange is seedless, and this fact is important, for without the processes of grafting and budding, and the use of cuttings (which is a slow means of propagation), it would be impossible to perpetuate the variety.

Brazil is the home of this orange, where it arose as a "sport." It possessed so many obvious advantages over the other varieties of oranges, that for its commercial perpetuation a rapid and sure means of propagation was desired. The means, rapid, easy and reliable, was at hand—budding—a form of grafting in which only a single bud, with or without adhering wood, was used as the scion—the stock, the rough lemon or citron. Since then, in a comparatively few years the navel orange has spread over the world, and forms to-day one of the most common and popular varieties of orange.

Most of our varieties of fruit trees are budded or grafted—they are kept true to name and variant factors are kept at a minimum. When these variant factors do arise, possessing exceptional qualities, then they, too, can be perpetuated. The varieties of navel oranges again form examples.

2. Grafting is employed also to mitigate the ravages of disease—particularly for such fruits as the apple, citrus, and the grape vine. Most apples are in Australia grafted on to "Northern Spy" stocks for the reason that this variety of apple is very resistant to the root attack of Woolly Aphis (*Shizoneura lanigera*).

European grape vines are grafted in most other countries of the world on to American varieties. The reason being to prevent the practical extinction of the varieties of the *Vitus vinifera* due to the ravages of the terrible disease known as Phylloxera, caused by a species of aphis known as *P. vastatrix*. This disease was introduced into France during last century on stocks imported from America to minimise the effects of the fungus disease known as Powdery Mildew (*Oidium*). The ultimate result was the complete annihilation of the European vines, except in some isolated areas. This meant that fresh plantings had to be made of grafted vines and cuttings—all on American stocks which are very resistant to the disease.

Vinegrowers in Western Australia are particularly fortunate, for this dread disease is not present.

3. Grafting may modify the stature of the plant. One may desire dwarf trees, and these may be obtained by using for apples the stock known as "Paradise," and for pears, quince stocks.

4. Grafting is also very useful, in many cases imperative, for the adaption of varieties of fruit trees to various soil types. It is common knowledge that the various kinds of fruit trees have individual tastes concerning location, soil, and climate, and grafting is used to modify these preferences. Plum stocks are used for peaches on heavy lands, and *vice versa*, peach stocks for plums on light lands. In some chalky districts in England almond stocks are used for apricots. These are a few examples only of stock modification of varietal preferences.

5. Grafting, including budding, is very useful in nurseries to accelerate the fruitfulness of new varieties of fruits under test. One would have to wait a considerable time for a seedling to fruit naturally, but by using grafts and buds we are able to secure results in a very short space of time.

Grafting, although not a new method, may be freshly adapted to meet varying conditions of soils, and to change over unprofitable varieties of fruit trees to those better suited to climatic and market requirements.

The terms used in grafting will be understood by most, but for those not so conversant a few explanations will be necessary.

A graft is composed of two components—one, the scion, the portion of the plant one desires to propagate, whether bud, spur, terminal shoot, or matured wood one season old, and the other the stock, or host plant. The stock, whether root, trunk, or limb, nourishes the scion if the union is congenial, permitting its growth and the retention of its varietal characters.

However, these varietal characters may be subject to modifications, as shown by recent research. Certain modifications one may remember, such as (a) dwarfness, (b) the adaptive nature of certain stocks for soil types, (c) increased vigor, and (d) many other modifications not usually noticed, but nevertheless playing very important parts.

Many fertiliser experiments on fruit trees have been failures, due almost entirely to the non-standardisation of stocks affecting the standardised scions, leading to results at once misleading and meaningless, even though carried out for thirty or forty years.

For most practical reasons, however, the propagation is true to type wherever the union of stock and scion is congenial. The scion is inserted into the stock by means which we will later explain, and commences to grow if the conditions are favourable. These can be enumerated –

(1) The contact between scion and stock must be perfect so that the cambiums are in close proximity. The cambium is that part of the plant that separates the xylem, wood, or water conducting and skeletal system of the tree from the phloem, or food conducting system. In young wood this cambium has the wonderful power of regeneration, furnishing wood cells on the inside and phloem on the outside. The cells occurring in the cambium are analagous to those found in the growing points of shoot or root. They are actively alive and are capable of fresh growth. It is now obvious that for a successful union these portions of our components must be in close contact so that by the rapid production of callous tissue the union is initiated before the scion is subject to the hot rays of the sun and desiccating winds.

(2) There must be a close affinity between stock and scion, *i.e.*, there must be close relationship botanically, though exceptions occur as they do in most rules. The flowering plants are divided into two sections—the Monocotyledenae and the Dicotyledenae: the former including the cereals and grasses, and the other our fruit trees. As one easily sees there is no affinity between a grass and a fruit tree. The Dicotyledenae is divided again into families, viz., the Rhamnales includes the grape vine and the Rosales includes the apple and pear trees. Therefore, the families are groups of plants possessing characters differing widely from each other, and are again lacking in affinity. The families are further divided into genera, each possessing allied features—for instance there are two genera in the Rhamnales, of which one is the Vitaceae, and seven in the Rosales. The genera then confined to a family are more closely connected, but still it is remarkably difficult for intergrafting to take place except in rare instances. The genera are further divided

into species. In the genus Vitaceae we have, amongst others, the following species:—

(a) *Vitus vinifera*, the European grape vine as grown here;
(b) *V. labrusca*]
(c) *V. riparia* — American vines.
(d) *V. rupestris*]

Here there is a fairly close affinity, but not so close as one would expect. The American vines form stocks of varying utility, and the unions are often bad. Even amongst a genus the affinities of species for each other may still be poor. The change over to American stocks in other parts of the world entailed a tremendous amount of research work and many resultant failures and still the lives of the grafted vines are comparatively short.

The species are again divided into varieties. There are the Muscats, the Malagas, the Sultanas, the Red Princes, the Ohanez and thousands of others. Usually the affinities between these varieties are quite good and grafting is easily accomplished, but again we find that these varieties have individual tastes for soil, location and climate and much remains to be done to render desired varieties successful on stocks that in certain soils and locations on their own roots would be failures or else only partial successes.

For successful grafting a close affinity is necessary, and one finds it chiefly amongst varieties where, even there, it may still be a variable factor. The quince and loquat furnish an example of close affinity where the members of the union do not belong to the same genus.

(3) *Season.*—The usual time for grafting is in the spring at leaf-burst when the soil is moist and conditions ideal. The roots had commenced activity weeks before in preparation for the work ahead of them. The condition of the tree at this stage can be compared to a greyhound straining at the leash—all eagerness for the chase. The cambial tissues have the reserves of last year's growth and the early preparation of water and mineral requirements by the roots behind them, and they are eager and ready for the moment to commence growth. It is not surprising, then, that this is the ideal time for grafting, where the unions rapidly callous and growth commences, before the severe conditions of summer make themselves felt.

Other forms of grafting can be done at various times during active growth, viz., herbaceous grafting.

Budding can be done either in the spring or December-January for deciduous trees, or in the early autumn for citrus trees. The dormant buds give much better results.

(4) *Implements and Materials.*—The implement, of course, can do much to make or mar a successful graft, even when all the other factors have been favourable.

The grafting knife must be strong, finely bladed and possessing a keen edge. All cuts must be smooth and clean, thus ensuring a rapid callousing of the wounds. The mallet, or—as is sometimes used when much grafting is to be done—a wooden club, retained on the wrist by means of a leather hand, must be strong and not too heavy.

The implement used for cleft grafting consists of—

(a) Handle.
(b) Blade—the extended portion forming a stout and sharp cutting edge.
(c) The distal extremity is curved upwards in the form of a wedge.

This tool is very convenient, the cutting edge, by the force of the mallet forms the cleft; when withdrawn and the wedge inserted, one is able to shape the stock, insert the grafts and when the wedge is withdrawn the scions are held firmly in position.

All implements, including saws, etc., must be kept clean and in good condition, for when one stops to consider one realises that a clean, healthy wound heals much more readily than does a dirty, ragged one.

The graft when made must be protected from the weather, otherwise drying winds would promptly end all chances of success. Therefore, all the winds must be amply protected and this is done by the use of grafting wax, waxed calico or muslin, or grafting clay.

A good grafting wax can be made from the following formula: -Resin, 2 lbs; beeswax, 1 lb.; tallow, 1 lb. This is applied by means of a brush—hot, but not too hot—over all the wounds.

The waxed cloth may be made by passing the strips of cloth from two rollers through the hot prepared wax and, by means of boards, stripping off the surplus. When dried it can be rolled and used when required.

The grafting clay is sometimes utilised, but it is more used when one is grafting vines A useful formula is as follows: Clay, 2 parts; rotted horse manure, 1 part; plus a little chopped hair.

(5.) *Treatment.*—The care meted out to the grafts is usually meagre. They reward careful attention by well directed growth, free from the competition of water shoots that often on vigorous stocks arise in profusion.

It is necessary—

(a) To bind the grafts, especially in windy locations, to stakes attached either to the limbs or fixed in the soil. Many losses occur every year that can be directly attributed to the force of the wind on unstaked grafts. The first callousing is, of course, composed of soft tissues that possess no strength of cohesion. Later the strength that very seldom becomes a weakness in the tree is developed.

(b) That the raffia or bindings used in tying the grafts must be removed before they become a menace in constricting the union as the graft comences vigorous growth. Many unions are ruined in this way.

(c) That water shoots and competing growths must be removed, otherwise the flow of sap is diverted to the stronger channels to the detriment of the graft. In some instances it is wise to retain such growths in order to subdue to some extent too vigorous scions, whose rate of growth is out of proportion to the rate of strength developed in the union.

This restraint on the scion can be applied also by judicious pinching out of the growing point. The rate of growth is checked and time is thus given for strength to develop in the union.

The care of the graft is amply repaid by strong well-directed growth capable of easy manipulation, and in the following season rewarding the operator by increased fruit production. Alas, too often is the graft left to struggle, unaided, by itself, and in the event of failure—only too common—the system, and not the operator, is to be roundly condemned, and, therefore, useless.

The preceding are, briefly, some of the factors affecting grafting. The subject is extremely large, and the scope of this article does not permit us to further enlarge on this particularly fascinating subject.

The following is a broad outline of the systems of grafting commonly used. We have done some considerable work on such methods of grafting that apply to the grape vine, the fig, the apple, citrus, and stone fruits.

Methods of Grafting.

I. Bud grafting or budding.
II. Grafting proper.
III. Bridge grafting and in-arching.

I. *Bud Grafting.*

(a) *Shield budding.*—The name "shield" is derived from the resemblance of the cut bud to the medieval shield. With deciduous trees, well-developed buds are cut from healthy shoots during the months of December, January, and February. By means of a T-shaped cut just reaching to the wood they are inserted into the stock and firmly bound with raffia or wool. This can only be successfully accomplished when the so-called bark comes easily away from the wood. The ligatures require to be removed 8 to 14 days after the operation, and the bud remains dormant until the following spring, when the stock above the bud is removed.

(b) *Flute budding.*—This method can be used for fig and walnut trees. The bud is obtained by two parallel and two perpendicular cuts into the bark: in the former case about half an inch below and above the bud, and in the latter about the same distance from the sides of the bud, which can then be easily detached. The shape is now fluted; hence the name.

The bud on the stock where the scion is to be received is cut similarly and removed. The exchange can now be accomplished, and the union is bound firmly with wool or raffia, care being taken not to cover or injure the bud proper. Flute budding is usually recommended in the spring for figs. Somewhat later in December it is used in other parts of the world for grape vines.

II. *Grafting proper.*

There are many systems in vogue but the following are in general use and most conditions in Western Australia. They will be discussed in detail later.

(a) *Whip and Tongue Grafting.*—This is, perhaps, the graft in most common use. It is particularly adapted for stocks of small diameters, and is extensively used by nurserymen for such trees as the apple and pear. It can also be applied by the orchardist to nearly all deciduous fruit-trees.

(b) *Strap Grafting.*—This form of grafting is an ingenious device for the grafting of stocks of large diameters, ensuring a quick and sure covering of the stump. Strap grafting is, perhaps, the most efficient system we possess, and can be applied to apple, pear, and stone fruit trees.

(c) *Cleft Grafting.*—Presenting such ease of operation, cleft grafting is used extensively in the field for such fruits as the apple and pear, stone fruits, figs, grape vines, mulberries, and citrus.

(d) *Bark Grafting.*—This method of grafting, with several modifications, is also commonly used for such fruits as the apple, pear, stone fruits, mulberries, figs, and citrus.

(e) *Inlaying.*—As will be seen later, inlaying presents features that appear to be admirably suited to the grafting of grape vines.

(f) *Herbaceous Grafting.*—The green shoots are used in this form of grafting. It is extensively used in European countries for grape vines, and is seen here practised by Slav workers in the Swan and Spearwood districts.

(g) *Bottle Grafting.*—The late Mr. Catton Grasby introduced this graft from abroad. Though tedious in maintenance, this system is an admirable and sure method of overhead working the grape vine.

III. *Inarching.*

Skin grafting and blood transfusions as practised by the surgeon have interesting corollaries in the realm of the horticulturist. The system of inarching seeks to transfuse new life into a tree weakened by root injuries, and the following method—

(b) *Bridge grafting* seeks to correct trunk wounds too large to deal with in Nature's way.

GRAFTING THE GRAPE VINE.

Grafting to many vignerons does not appear to be worth the trouble, nor to be worth while. We assure them that it is, and that returns are obtained much faster than from fresh plantings. Usually, it is most difficult to secure vigorous growth from initial plantings in situations where old vines have stood for years, unless the soil is removed and fresh good soil substituted.

The stock method of grafting is the cleft graft noted for the ease and comparative success of its operation.

It is performed in the Spring when the shoots on the stock are several inches in length and the sap pressure somewhat reduced. The scions are obtained from those stored during the winter months in moist sand. The stock is cut with the saw on a level, or a few inches above, the surface of the ground. The cleft grafting implement is placed diametrically across the stump and the force of the hammer or mallet ensures the splitting of the stump to a distance of three inches, when the implement is withdrawn and the wedge-like distal extremity is inserted into the cleft. While still in position, the cleft on each side is cut, starting from an inch to an inch and one half from the top, in a triangular fashion, being careful that the cuts are clean and smooth, not too deep nor yet removing too much wood.

The two scions are now selected—firm, healthy, dormant canes, consisting of one to two buds each. They are given a slanting cut on one side through the pith. On the other side a cut is now given to expose the cambium, not through the pith, to form a triangular wedge that fits exactly the excavations made in the stock. (See Fig. 1.)

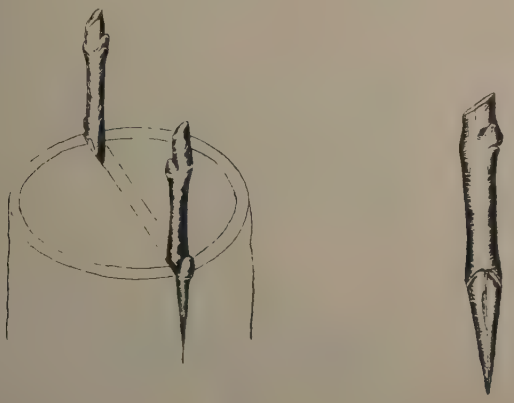


Fig. 1.

The two scions are now inserted, care being taken that they fit perfectly, and that the cambial layers of stock and scion are in close and intimate contact. The wedge is carefully withdrawn and the scions bound with raffia or twine.

It is preferable to bind the grafts, otherwise dislodgments are possible, ruining all hopes of success. After tying, grafting clay is pressed firmly and carefully over the stump to cover the surface of the wound, though this can be dispensed with. Soil is now heaped over the graft to a height of about 15 inches to prevent desiccation and to permit the union to take place. If the soil is very clayey, it is advisable to finish the heaping process with a layer of sand, otherwise the clay may become caked, and the growth of the scions have difficulty in growing through it.

The scions commence growth amidst a profusion of suckers and water shoots, and care must be exercised that the scion is not permitted to play a minor role subservient to such growths. Sometimes if the scion is growing too rapidly a weakness may develop at the union, and in this case it would be wise to allow some sucker growth to take place, or else to pinch out the growing points of the scion shoots.

Fig. 2.

The above illustration depicts a Red May grafted on to Muscat of Alexandria. The Muscat was cleft-grafted on the 24th September, 1930, when seven years old. That the graft made excellent growth is evident. Similar growths were obtained from Red Prince, Purple Cornichin, Chasselas and Wortley Hall—all on Muscat stocks.

Fig. 3.

The earth has been removed from the base of the vine, exposing the excellent union, and the tendency of the vigorous scion to establish itself on its own roots.

The cleft graft, however, is difficult when it is desirous of grafting twisted stocks, and the following method overcomes this:—

Grafting by Inlaying.—The stock is cut down in a similar manner to that described under cleft-grafting (Fig. 3).

The implement used to form the inlay, parallel to the long axis of the stock, is a half-inch triangular gouge that forms a clean triangularly-shaped wound an inch or so in length, and from a quarter to a half-inch in depth, on the most projecting side of the stock. If the stock is straight, the inlay is made anywhere just above ground level.

The scion, 14 to 18 inches in length, is cut on one side to fit the inlay by cutting to the pith, to meet another cut exposing the cambial layer, just below the second bud from the top. A hole is then dug to take the length of scion and the graft is secured by firmly tying with raffia. Care, of course, must be taken that the cambial regions of stock and scion are in close and firm contact. The earth is heaped over the stump as for the cleft graft.

The scions for this graft need not necessarily be dormant: a slight bud burst has been successfully used in a Caversham vineyard. Six vines were grafted—five by the above method, and the other by adapting the cleft of the cleft-graft to take the place of the inlay. They were all successful, making vigorous growth that compared more than favourably with neighbouring vines cleft-grafted. The stocks used were muscats, and the scions currants. No misses were recorded—a fault that sometimes occurs with cleft-grafting even if performed in a capable manner. (See Fig. 4.)

Fig. 4.

Fig. 4 shows an excellent example of the currant cutting inlaid into the muscat. The graft was done in September, 1931.

The following, I think, are some advantages that this system of grafting suggests:—

(1) It permits knotted and twisted stumps to be grafted.

(2) On weak-growing vines the stock acts as a nurse, nourishing the scion until it can establish itself on its own roots. The deep planting of the scion enables roots to be formed out of danger from the reach of cultivating implements.

(3) The deep planting of the scion enables it to withstand drying conditions better, the moist subsoil being analogous to the bottle of the bottle graft, keeping the scion moist until the union takes place. Really the scion starts life as a cutting, then as the union is consummated, as a graft, to be followed later by a phase of symbiotic existence, and then ultimately, if required, to establish itself on its own roots.

(4) The scion being so firmly held in the soil proves more difficult to dislodge.

(5) If it is intended that the scion should not establish itself on its own roots, the lower portions can be removed when the union has become safe enough for the purpose.

BOTTLE GRAFTING.

This curious method of grafting (see Fig. 5) can be used at any season of the year, when partially or wholly matured wood is available. It is the only sure means of overhead grafting that we possess, though we have been successful in some overhead cleft-grafts carefully waxed.

Instead of the moist subsoil, the bottle, filled with water, enables the union to take place before drying conditions eventuate to kill the scion. In all cases observed, contrary to deciduous fruit-tree grafting, the bud-burst precedes the callousing over of the union, and it is thus why the overhead working of the vine is so difficult.

The part of the stock to receive the scion is obtained usually on a spur, as close as possible to the main arm.

The scion varies in length from 8 to 10 inches depending upon the depth of the container used. A slanting cut just below the topmost two buds is made reaching to the pith, pointing to the lower extremity of the scion. The edge of the lip is on the outside for a quarter to a half-inch cut to a cambial layer. The stock is now treated in the reverse manner, care being taken to ensure that the lower extremity of the scion will be pointing downwards. The lip of the stock is treated in the same way as that of the scion and the graft is effected by bending back both stock and scion. A firm intimate contact is essential.

The graft is firmly bound with raffia, and a bottle or any container with a narrow neck, permitting a minimum amount of evaporation, is to be used. It is filled with water and fitted over the hanging portion of the scion and fixed securely.

The only maintenance necessary is that the water level should never recede beyond the end of the scion.

The Bottle Graft.—Muscat on Black St. Peter, grafted in March, 1931, although in an inferior position made good growth, and ripened two bunches of fruit. The lower extremity was kept in water until the union was effected. It is now dead and can be removed.

In a suburban garden we obtained excellent results from this graft by performing it in March. In the following Spring a strong healthy growth ensued, and at the end of November the lower portion of the scion was found to be dead. The union was excellent.

This method suggests, if the vine is to be commercially top-worked, that two spurs, as near as possible to the trunk, should be grafted. From these two grafts

subsidiary main arms could be established that when developed enough could take the place of the old. During this time the crop of the vine has not been seriously interfered with.

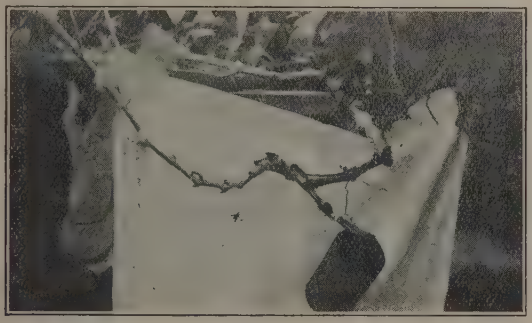


Fig. 5.

The method involved in bottle grafting is simple and most efficient. The chief criticism is that a fair amount of attention is required filling the containers during the summer months when the vigneron is working at full pressure.

HERBACEOUS GRAFTING.

We have seen excellent examples of this form of grafting.

The vigorously growing cane, when it attains the diameter of one's little finger, is cut with a short, slanting cut about an inch from the basal bud. The scion approximating to the same thickness and at the same stage of maturity is cut in a similar way, leaving only one bud, and placed to fit exactly over the exposed surface of the stock. The graft is then bound with wool or rubber bands. A considerable degree of judgment is required in selecting both stock and scion.

We are not in favour of the method adopted in the grape districts, where the stock, usually old, is cut down during the winter months a foot or so from the ground. During the spring a water shoot—if one is lucky—springs from the stump, and that is the one selected for the operation.

The old stump is then left to the mercy of the weather, roughly hewn, inviting the inroads of fungal parasites and the depredations of white ants.

The utility of this type of grafting, apart from decorative reasons, lies in the same direction as the bottle graft. Spurs situated on the main arms, near the trunk, can be worked over later to take the place of the main arms.

GRAFTING THE FIG.

The fig has generally been regarded in the past as difficult to graft. This we found was not substantiated. The fig is easy to graft (see Fig. 6), but the stock must be vigorous: the callousing process takes a long time, and in weak stocks the scion dies before a union of the surfaces in contact can take place. The chief methods of grafting this tree are—

(1.) *The Cleft Graft.*—Here the graft is overhead and care is necessary that the whole tree is not grafted in the one season, and that the grafts are carefully waxed. In the section on apple and pear grafting the system will be more fully described.

Cleft Grafting—the Fig.—The success of the operation is obvious. The grafts were done in September, 1931, finalising the top-working of the tree commenced in 1930.

Fig. 6

(2.) *Bark Grafting.*—The method involved in this system of grafting will be described in detail later. The same precautions as in cleft grafting must also be observed.

We have obtained equally satisfactory results with both types of grafting. The scion growth has been vigorous, but care is necessary that the profusion of sucker growth does not smother or dwarf the grafts that are usually later in starting growth than other kinds of grafted trees.

GRAFTING THE APPLE AND PEAR.

These are two of the easiest kinds of trees to graft, and the usual method of changing the variety or "top working" is by grafting. The stock of the apple is often propagated by root-grafting, and is practically the only stock treated in this way.

When top working an old tree to change the variety, it is usual to cut the top of the tree back to the secondary arms using a sharp fine-toothed saw. If the tree is very large it may be advisable to spread the operation over two seasons, doing one half of the tree one year, and the remainder the following year. Another method of dealing with large trees is to cut the limbs off at a considerable height and insert the grafts there. This usually means that many extra scions must be used, but it lessens the shock to the tree, and the resulting rapid growth of the scions makes the extra trouble well worth while.

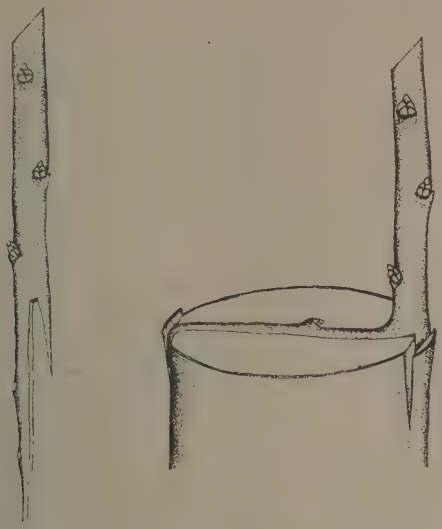
After the tree has been cut back, one must decide which method, or type, of graft should be employed. This is governed largely by the size of the limb or stock to be grafted.

For limbs up to three inches in diameter the cleft-graft gives good results. The chief advantages of this method are that the scions are held firmly in position without the necessity of tying, and that, unlike the bark graft, this method can be done before the bark lifts easily. One disadvantage is that the cleft or crack may harbour disease, but if the work is carried out carefully this possibility is almost negligible.

METHOD OF CLEFT-GRAFTING.

After the stock has been sawn off, trim the rough edges of the bark with the knife, and then with a wide chisel or grafting tool split the limb across the diameter to the depth of 2 to 3 inches. Insert a hardwood wedge to hold the cleft slightly open while the rough edges of the cut are trimmed smooth and to a narrow V shape.

Next, select the scion (usually three buds are sufficient), and cut it wedge-shaped and slightly thinner on the inside. This will ensure a firm pressure being kept where the cambian layers contact. When cutting the scion for this, and all other grafts, make the cut in such a manner that the top or terminal bud will be facing the direction that you wish the graft to grow. When the scion has been cut to fit snugly in the cleft of the stock, insert it in such a manner that the two cambium layers are in contact, then withdraw the hardwood wedge, thus allowing the two sides of the stock to hold the scion firmly in position. Unless the stock is very small it is usual to insert two scions, one on either side of the cleft. When the scions are firmly in place wax over all cut surfaces and the job is complete.



1 2

Fig. 7.

1. Showing method of cutting scion for strap grafting.
2. Scion inserted and ready for tying and waxing.

Method of Strap Grafting.—Where the limb of the stock is over three inches in diameter, it is advisable to use the "strap" graft. This method is somewhat more involved than the cleft, but gives very good results, and the cut end of the stock is more quickly healed over. When using the strap-graft the stock is cut and smoothed off in the same manner as when using the cleft.

The scion needs to be a comparatively long one. In gauging the length of the scion, allowance must be made for the diameter of the stock. Allow the usual three buds, the diameter of the stock plus about two inches for the "turn down" on the

opposite side. Thus, to graft a stock four inches in diameter one would need a scion about nine inches long. To shape the scion, make a long sloping cut, starting about three inches below the third bud and cutting one-third of the way through the scion, and to within half an inch of the bud. Then start from the bottom of the scion at the opposite side and cut a thin strip of bark and wood right up level with the top of the previous cut. Then turn the knife a right angles and cut through to the first incision. This will give a scion shaped as per diagram.

Now raise the bark on one side of the stock and insert the shorter side of the scion (marked A in diagram), turning the longer side, B, at right angles so that it lies across the diameter of the stock. Bend down the projecting end, and after opening or raising the bark, insert this bent-down portion as shown.

If the edge of the stock is rounded off it will prevent the "strap" from breaking at that bend.

The stock is then bound round with twine to hold the scion in position, and then the whole of the cut surfaces are covered with wax or clay to exclude the air.

Fig. 8.
Apple tree 14 months after top-working. Cleft- and strap-grafts were used.

Fig. 9.
Apple tree second season after top-working, showing vigorous growth of top.

Method of Bark Graft.—Another type of graft often used in conjunction with the "strap" graft on a large limb is the bark graft. This is a very simple graft and consists of merely cutting the scion with a long sloping cut to form a "chisel point." This is then inserted under the bark in a similar way to the two separate points of the strap graft. After tying in place, wax or clay is used to exclude the air.

One big drawback of this method is that until the growing scions have healed on strongly they are very apt to be blown out by the wind.

Method of Whip and Tongue Graft.—If one desires to graft very small limbs, say, up to three-quarters of an inch in diameter, the "whip and tongue" graft may be employed. This is the method generally used in root grafting apple stock. It gives best results when both stock and scion are nearly the same diameter.

The stock is prepared by making two sloping cuts. The first is the downward cut, which should be a little over an inch long, turning slightly with the grain, and cutting about half-way through the stock. The second cut is made upwards, commencing from the opposite side level with the bottom of the first cut, and meeting the first cut, at a very acute angle, near the middle of the stock. These two separate cuts leave a long sloping surface with a wedge like a tongue.

The scion is prepared in a similar manner, but in this case the position is reversed and the upward cut is made first.

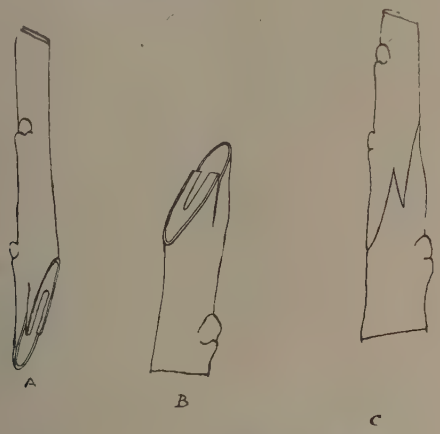


Fig. 10.
Illustrating whip and tongue graft—
(a) Scion.
(b) Stock.
(c) Completed graft ready for tying.

The stock and scion are then fitted together, and if they are of the same diameter will form a neat and firm joint with the cambium layers in contact all round. If the stock and scion are not of the same size, make sure that the cambium layers contact on at least one side. The graft is completed by binding with waxed cloth or by tying with raffia and waxing over.

There is another type of graft which is sometimes used—the side graft.

Method of Side Graft.—Where a big tree has been worked high up, the side graft is used to form new laterals or fruiting wood on the old limbs. It is also used to form an extra "leader," where another variety is needed for cross-pollination. In using this method of grafting it is not necessary to cut the stock back as the graft is inserted in the side.

An oblique cut is made in the side of the stock with a thin chisel or a strong knife, and the scion, after being prepared in a similar way to that of the bark graft, is inserted and tied in position. As in all other grafts care must be taken to see that the cambium layers are in contact.

Where this method is used to form a new leader the top of the stock can be cut off after the graft has taken.

Fig. 11.

Graft of Packham's Triumph Pear, which bore fruit during its first season: eight pears which matured aggregated 5¼ lbs. weight.

GRAFTING STONE FRUIT.

When top working any of the stone fruits—peaches, plums, apricots, etc., the general practice is to cut the tree back to the secondary arms while the tree is dormant, and then bud the resulting fresh growth during the following summer. A quicker result may be obtained by cutting the tree back during the early spring and grafting in the same manner as when top working apples and pears.

We have seen peach trees worked in this manner make over six feet of growth during the first season, and produce nearly a bushel of fruit the following year. (Fig. 12.) The advantage of this method is that if the grafts should fail the trees always makes sufficient new growth suitable for budding in the usual

Fig. 12.

Five-year old peach tree showing vigorous growth during first season after top-working by method of cleft-grafting. During the next season this tree carried over three-quarters of a bushel of fruit.

manner. Although stone fruit can be satisfactorily top-worked we do not recommend this operation on trees that are over twelve years old. The grafts will probably take alright, and may produce quite a good tree, but the cut stump is usually

very slow in healing over. Dry Rot and even white ants are very liable to gain access and so weaken the stump, that when the rejuvenated top is carrying a nice crop of fruit the main limbs will break down and the tree is ruined.

Most varieties of stone fruits may be worked one on to another, *i.e.*, plums on to peaches, and *vice versa*, but it is generally safest to keep the plum stocks only for plums. English plums top worked on Japanese plums and the reverse operation are not always satisfactory. The peach stocks gives good results all round, but especially as a stock for plums and apricots on light soils.

Care must be taken when working English plums on to peaches, for some varieties do not make a good union. The Grand Duke, for instance, seldom unites satisfactorily. It generally grows vigorously, but there is always an unsightly bump where the union has taken place.

Where it is desired to work the "Grand Duke" on to a peach stock, it is necessary to double work the tree to get a neat union. The peach is first worked with a variety such as the "President," which will make a good union, and then the "President" is later worked over to the "Grand Duke."

Peaches and plums generally take well on to almond trees, and we have had good results when top-working apricot trees with peaches and Japanese plums.

The same types of grafts as used for the apple and pear may be employed in grafting the stone fruits.

GRAFTING CITRUS.

Citrus trees may be top-worked like any other kind of fruit tree. Although budding is generally employed for this operation we have had excellent results with grafting. As with top-working other varieties of trees, if the grafts happen to fail one can always resort to budding later on in the season.

In grafting citrus it is advisable to cut back only about half the number of limbs during the first year so that sufficient top is left to shade the main limbs which are very prone to sunscald. The remaining limbs may be cut back and grafted during the following year. This method also allows one to harvest a portion of the usual crop for a season after the first grafts are inserted.

Best results are obtained by grafting citrus early in October, just before active growth commences, and before the weather becomes too hot.

The cleft-graft, as described for the apple and pear, is very successful for top-working the orange. The scion should be cut from good round wood of one to two years old and should be about the thickness of a lead pencil.

Another graft which may be used with good results is the "Crown" graft, as used when grafting the grape vine. In this case the main trunk is cut off at ground level and several scions are inserted, either the "cleft" or the "bark" graft may be used. The whole lot is then covered with soil leaving only the top buds protruding. After growth commences all but one—the most suitable scion—are removed. The selected one is then trained as a new tree. This method has a serious drawback in that the sawn-off stump left in the ground is liable to rot, and to harbour the Armillaria fungus, which is a serious trouble with citrus.

Bridge grafting and inarching are two special modifications of the practice of grafting.

Bridge grafting, as its name implies, is generally used for bridging over any extensive injury to the bark of the trunk or main limbs of a tree.

Fig. 13.

Poor affinity. Grand Duke worked on peach stock. To prevent this it is necessary to double-work the stock.

Fig. 14.

Thirty-year old orange tree eighteen months after being top-worked by means of cleft-graft.

Fig. 15.

Five-year old peach tree inarched to renew part of root system destroyed by Armillaria.

The operation is performed by taking a scion—usually the same variety as the tree being treated—several inches longer than the length of the injury to be bridged. The scion is shaped at both ends in the same manner as when doing the bark graft. An opening is then made an inch or so below the injury by making a "T" cut through the bark and raising the two edges. A similar opening is made just above the injury by making an inverted "T" incision.

The scion is then bent bow fashion while the two ends are inserted in their respective openings. The scion is then allowed to straighten and the shaped ends are forced into position under the bark with their cambium layers in contact with the cambium of the stock. The graft is then tied in position and covered with wax or clay.

If the operation is being done before the sap is moving, *i.e.*, before the bark lifts readily, the scion may be inserted by making an oblique cut through the bark into the wood instead of the "T" incision. One must then use extra care to make sure that the cambium layers are in contact.

Bridge grafting has its special value in saving trees that have been partly or wholly ringbarked by bark-eating animals, or by the attacks of fungus diseases such as Collar Rot and Fire Blight. It is quite safe to bridge-graft any injured tree provided the bark is healthy immediately above and below the injury. In the case of a large injury, two or more scions may be inserted so that there will be less check to the normal flow of sap.

Where a tree has had a severe injury to the trunk and there is no healthy bark below the injury, the tree can often be saved by "inarching." This operation consists of planting a young tree, or cutting, close to the trunk of the injured tree and then grafting or inarching it into the healthy trunk above the injured portion. The method of operation is similar to that of inserting the top end of the scion when bridge-grafting.

The young tree or cutting must be planted during the dormant season. Although the inarching is best left till both trees are showing signs of growth, we have had good results with inarching apple-trees at various times between August and November. The scope of inarching is much wider than that of "bridge grafting," for it may be used not only in case of injury to the trunk, but also, if necessary, to give a tree a complete new rooting system -perhaps of a different variety from its original system.

Fig. 15 shows two peach seedlings inarched into a five year old peach-tree in an attempt to renew part of the rooting system which was destroyed by Armillaria.

Fig. 16 illustrates the trunk of an eight year old "Granny Smith" apple-tree which, after being blown down by a gale last autumn, was inarched to strengthen the rooting system on the weaker side. In this case, again, two inarches were made. The one on the right hand is a Northern Spy "whip," while the one on the left is a portion of Northern Spy root of about five-eighths of an inch in diameter.

The trees in both these illustrations have been benefited by inarching and appear to be on the way to recovery.

CONCLUSION.

Apart from the commercial systems of grafting, there are many types of fancy grafts that can afford much pleasure to those interested. The various forms of grafting by approach can increase the size of show fruit and can interlock trees and branches together into fantastic shapes. The procedure of the grafting operations is similar to the method described previously under inlaying the grape vine or under inarching.

Fig. 16.

Eight-year old Granny Smith apple tree inarched to strengthen rooting system. On the left shows piece of root inarched; on the right is young Northern Spy whip.

In conclusion, we would like to emphasise that for successful grafting one must carefully observe—

(a) The condition of the tree or vine—if too old, or diseased in any way, it is preferable to use fresh plantings.

One sometimes sees instances of old trees grafted. For a time the scions make vigorous growth until the previous balance between the roots and the aerial portion is reached. The tree then relapses into its former condition of senility.

(b) The affinity between stock and scion. This must be ascertained from an authoritative source.

(c) *Method.*—Whatever method of grafting is used the work must be done carefully, and the cambial layers of stock and scion must be in close and intimate contact.

(d) *Season.*—The tree or vine must, together with the scions, be chosen at the right stage of development.

(e) That care of the growing scions is necessary for successful results.

The following quotation from Shakespeare very aptly illustrates the fact that man, by careful attention to Nature's rules, can assist and initiate the work performed by her, but the completion of the work is Nature's, and Nature's alone.

"You see, Sweet Maid, we marry
A gentle scion to the wildest stock:
And make conceive a bark of baser kind
By bud of nobler race: this is an art
Which does not mend Nature: change it rather: but
The art itself is Nature."

TURKEYS IN WESTERN AUSTRALIA.

A. C. Jenyns, Poultry Adviser.

Turkey rearing is coming so much to the fore this season that the growing demand for quality is causing breeders to take notice and improve their stock with a view to better markets. The fact of a possibly large market overseas has caused a large increase in the possibilities of turkey farming. In the past turkeys have only been a necessary evil on most wheat farms, being sent into market in very poor condition, with resulting low prices. To turn this branch of industry into a profitable side line there are a few leading points to consider:

1. Good stock to start breeding.
2. Free range on good clean land.
3. Plenty of green feed.
4. Comfortable housing.

The breed most suited to our conditions is the Bronzewing; it is of good size and of a hardy nature.

The stock birds should be chosen from breeders whose flocks and premises are free from disease. The importance of this is that once disease is brought on to the farm, it is very difficult to eradicate (Black Head and Coccidiosis are the two most serious diseases with turkeys, both being diseases that get into the soil and cause trouble year after year). The best breeding results will be obtained with well-developed second-year hens mated to a good young gobbler. Breeding with immature birds is the cause of a large percentage of trouble and difficulty in rearing the young stock which, even if reared, will not give satisfactory results.

In choosing the male bird for breeding purposes, one with length and breadth of body, deep breasted, straight breastbone, and not too long in the leg is the type most suitable for table birds. When the birds are mated one gobbler to 6 or 8 hens is sufficient, as one visit from the male fertilises the whole sitting of eggs laid by the hen.

Hatching should be done in the warmer months as young turkeys are very easily chilled, which results in lung congestion and severe diarrhoea, the best remedy for which is one drop of chlorodyne in a teaspoonful of water every three or four hours. Wetness and cold are the chief enemies of turkeys, and I am sure that if turkeys are kept warm and dry there will be little or no disease enter the flock.

Feeding should be carried out just as carefully as with poultry. A wet mash consisting of two parts pollard, one part bran, and 2½ per cent. bone meal is the best morning meal, with free range all day, and wheat at evening. It must be remembered that turkeys cannot be correctly primed without abundance of green feed. For the chicks, eggs, including the shell, crushed with stale bread and bran and pollard in equal parts, is a good feed up to 6 to 8 weeks old: after 6 weeks the mash given for the old birds can be fed. Cod liver oil added to the mash at the rate of 1 teaspoonful to 6 birds till 12 to 14 weeks will make a great difference in the development of the young stock; where the mash can be mixed with skimmed milk, the best results are obtained. Mashes should be moist, not wet.

Turkeys are a good marketable proposition on the local market if they are really prime. The possible development of an overseas market for dressed poultry will add to the interest of breeders of turkeys as there is, and will always be, a large demand for prime dressed turkeys. Size and fatness are the most important points, and these can only be had by careful selection of the breeding stock and proper feeding.

THE M. T. PADBURY TROPHY COMPETITION.

I. THOMAS, Superintendent of Wheat Farms.

This competition, which has been conducted for the past two years, was inaugurated as the result of a generous donation made by Mr. M. T. Padbury, President of the Primary Producers' Association, a past President of the Royal Agricultural Society and a prominent pioneer farmer of this State.

The allocation of the funds has been so arranged that a replica of the main shield is awarded to the winner each year of the competition, *i.e.*, the competitor who produces the highest acre yield of wheat per inch of rainfall during the growing season (May 1st to October 31st).

The conditions under which this competition is being conducted are as follow:—

1. The competition will commence with the 1930-31 harvest and continue for a period of 10 years. At the end of that period the trophy will be awarded to the competitor who has taken part in the competition for at least five years, and who obtains the greatest mean average acre yield per inch of rainfall during the conventional growing period. The mean average yield will be computed from the results of the five seasons in which the competitor produced the highest acre yield per inch of rainfall during the growing period. In the event of a tie the competition will continue between the leading competitors until an advantage is gained by one of them.

2. The conventional growing period for any year will be that decided upon and announced by the Royal Agricultural Society. For the first year, and until further notice, it has been decided that it will be from May 1st to October 31st, inclusive.

3. Until the end of the competition the trophy will be in the custody of the Royal Agricultural Society, and will be displayed at any agricultural exhibition held by that society.

4. Each year the competitor who obtains the best average acre yield per inch of rainfall during the conventional growing period will be awarded a replica of the trophy. His name will also be inscribed upon a small shield affixed to the trophy.

5. The rainfall upon which the award will be made will be determined by the Commonwealth Meteorologist from the district records, and his decision in this matter will be final.

6. The competition will be limited to those farmers who harvest at least 200 acres of wheat for grain. Where a competitor is financially interested in the crops grown on one or more farms, he will be required to supply details regarding the production and marketing of the crops on same, and, though usually the award will be made upon the results from the farm nominated by the competitor, yet the Royal Agricultural Society may require that the crops on these farms be included in the competing area.

7. The average yield will be ascertained from the total area—including self-sown crops—harvested for grain, and determined from the actual amount of wheat sold as shown by the delivery dockets, plus the amount retained for seed, for home use or for any other purpose.

8. The method of judging will be as follows:—At a convenient time the area harvested for grain will be measured and the quantity of wheat on hand ascertained. On or before January 31st, the farmer will be required to furnish the judge with a sworn declaration as to the quantity of wheat sold from the competing holding or holdings, and the amount retained for seed and other purposes; the statement regarding the amount sold to be supported by agents' dockets. The judge, after satisfying himself as to the correctness of this statement, will compute the average yield per acre per inch of rainfall during the growing period from the information received.

9. The judge will be appointed by the Director of Agriculture, and his decision will be final.

10. Nominations for this competition will be received by the Royal Agricultural Society up to the 31st October each year.

The acre yields obtained, although not quite as high as last year, when an official State record of 3 bushels 23lbs. per inch of rainfall was established by Mr. F. A. Williams, of Mangowine, are nevertheless highly meritorious. It is interesting to note that the general standard in the competition has been maintained. The average yield per inch of rainfall for last year was 2 bushels 11 lbs., and for the previous year 2 bushels 13 lbs.

The results for last season, the second in the competition, are set out below:—

M. T. PADBURY TROPHY COMPETITION—1931.

Competitor.	Address.	Rainfall during growing period.	Area harvested.	Yield.				
				Gross.	Average per Acre.		Average per 1in. growing period rain.	
		points.	acres.	bushels.	bus.	lb.	bus.	lb.
Atkins, F. M. and J. L. ...	Jouerdine	648	375	7,291	19	27	3	0
Moore, T.	Indarra	1,134	242⅓	7,677	31	39	2	47
White, R. H.	Gnowangerup ...	1,170	270	8,662	32	5	2	45
Stewart, W. B.	do.	1,170	200	6,131	30	39	2	37
Nottage, R. B.	Tammin	1,098	289	8,250	28	33	2	36
Smith, C. & Sons	Yarding	942	2,294⅓	53,686	23	24	2	29
Leah, J. & Sons	Bruce Rock ...	1,034	310	7,823	25	14	2	26
Williams, F. A.	Mangowine ...	836	349	7,044	20	11	2	25
Harris, E. G. S.	Mukinbudin ...	850	443	9,058	20	27	2	24
Allen, Bros.	Bruce Rock ...	1,036	753	18,581	24	41	2	23
Barnett, L. T. C.	Walgoolan	1,022	390⅓	9,433	23	37	2	19
Stevens, G. K.	Ghooli	804	203	3,766	18	33	2	19
Creagh, Bros.	Kwelkan	987	991	22,154	22	21	2	16
Beeck, H. O.	Gnowangerup ...	1,170	418	10,585	25	19	2	10
Bremner, J. R. & Sons ...	Corrigin	1,082	980	22,923	23	23	2	10
Manuel, C. J.	Mukinbudin ...	850	440	8,073	18	21	2	10
Horsman, H. & Sons ...	Bilbarin	1,082	356	8,062	22	39	2	6
Strange, P.	Yarding	1,034	398	8,660	21	46	2	6
Garnett, J.	Gnowangerup ...	1,170	263	6,417	24	24	2	5
Bothe, B. D.	Coorow	1,205	562⅔	13,806	24	33	2	2
Smith, C. and A. H. ...	Bruce Rock ...	1,082	1,127½	24,692	21	54	2	1
Cusbert, L. C.	Bruce Rock ...	1,082	402	8,573	21	19	1	58
Cuming, A. S.	Carnamah	1,497	323⅓	9,410	29	5	1	57
Riches, H. & Sons ...	Wyalkatchem ...	1,114	604	12,995	21	31	1	56
Finklestein, H.	Shackleton ...	1,055	524	10,616	20	16	1	55
Kingston, D. W.	Boodarockin ...	808	296	4,217	14	15	1	46
Richardson Bros.	Bonnie Rock ...	858	392	5,232	13	21	1	33
Carter, J. S.	Benjabberring ...	1,114	297⅓	4,337	14	35	1	19
Carter, H. R.	Three Springs ...	1,367	496	7,697	15	31	1	8

THE CANARY GRASSES OF WESTERN AUSTRALIA.

C. A. GARDNER, Government Botanist, and G. R. MEADLY, B.Sc.

The species of *Phalaris* dealt with hereunder are not all naturalised or cultivated in Western Australia on a large scale, but those species which are either naturalised, cultivated or at present being experimentally grown are included. The purpose of this paper is primarily intended for the determination of such species, hence the key to the species, and the more or less detailed descriptions of each. The incidental notes contain what may be of importance concerning the economics of each species, but our knowledge of the species of this genus is at the present time meagre.

The genus has attracted much attention during recent years because of the value of some of the perennial species as pasture plants. They have been shown, especially *Phalaris tuberosa*, to be valuable species because of their nutritive value,

hardiness, and adaptability to various soils, their permanency, and the quality of the sward produced, and, especially with *P. tuberosa*, the rapidity and seasonal incidence of their growth. Thus *Phalaris tuberosa*, the Toowoomba Grass, has come into favour in districts such as South-Western Australia, where it promises to become one of the principal constituents of our permanent pastures.

The Canary Grasses are so named because at least one of the species (*P. canariensis*) provides the canary seed of commerce. *Phalaris minor* shares in this to some extent also, but is usually an adulterant. While the former is largely grown in other countries for its birdseed, the species is not cultivated for this purpose here but is a naturalised alien which is spreading in several parts of the South-West of the State.

The species dealt with here may be classed regarding duration of life, status and uses, as follows:—

Annual species:

P. canariensis.—Naturalised alien, not, or little, cultivated, usually a weed of sandy soils.

P. minor.—Naturalised alien, also cultivated, but usually in mistake for *P. tuberosa*.

P. angusta.—Naturalised alien established near Guildford, a species which promises well for salt areas.

P. paradoxa.—Naturalised alien not yet well established. Of no known economic value.

Perennial species:

P. tuberosa.—Introduced species being planted in permanent pastures in the South-West.

P. caerulescens.—Species at present being experimentally grown, suitable for cultivation in the South-West.

P. arundinacea.—Introduced species at present being experimentally grown, suitable for wet lands.

The genus contains about 20 species, of which five are of importance, four of them being pasture plants and one grown for seed. All of these are at present being tried out experimentally with the single exception of *Phalaris caroliniana*, a North American species which is an important perennial species grown for forage in the Southern United States of America. It is apparently closely related to *P. angusta*.

PHALARIS, Linn.[*]

Spikelets with one perfect flower, compressed, densely crowded into a simple or lobed spikelike panicle. Rachilla disarticulating above the glumes: florets 1-7, of which only one is fertile. Glumes persistent, longer than the florets, keeled and often complicate, the keel usually produced into a dorsal hyaline wing, or sometimes the wing vestigial. Florets usually 3, the two lower reduced to sterile lemmas, sometimes equal, sometimes one small and scale like, or both minute, or (in *P. caerulescens*) absent. In *P. paradoxa* there are 6 sterile florets which are comparatively large, variously shaped, and form an involucre to the fertile floret. Fertile lemma lanceolate-ovate, compressed laterally, muticous, usually becoming suberustaceous in fruit, silky hairy or glabrous, pale-coloured. Palea about as

*Derivation obscure, but probably from φαλαρος—meaning "white crested," an allusion to the white wings of the glumes.

long as the lemma, included within its margins after flowering. Stamens 3. Style distinct, the stigmas plumose. Grain oblong, included in the lemma and palea but free from them.

Inflorescence a short or long usually dense and spikelike panicle, white or variegated green and white (assuming a violet tint in *P. caerulescens*) with green nerves, often papery at maturity.

Annual or perennial grasses with flat leaves and hyaline culm-embracing ligules, mostly native to the Mediterranean and neighbouring regions.

KEY TO THE SPECIES.

A.—Spikelets of one kind, each with one fertile floret.

a Keels of the glumes distinctly winged; panicle compact, spike-like or ovoid.

α. Panicle ovoid, rarely oblong, usually almost as broad as long; glumes with broad oblique wings; sterile lemmas more or less equal, more than half as long as the fertile lemma ... ... 1. **P. canariensis**, *Linn.*

β. Panicle oblong to cylindrical, often narrow; wings of the glumes not broad; sterile lemmas unequal, sometimes one or both absent, less than half the length of the fertile lemma.

I. Wings of the glumes entire or minutely serrate; at least one sterile lemma present; spikelets green and white, acute or shortly acuminate.

1 Only one sterile lemma present, the outer represented by a minute callous scale or entirely absent; outer glumes acute, often irregularly serrulate or fimbriate; annuals with fibrous roots; fruit acutely ovate ... ... 2. **P. minor**, *Retz.*

2 Both sterile lemmas developed, the longer one-third as long as the fertile lemma, the other smaller; glumes obtusely acute, entire; perennials with swollen basal nodes; fruit acutely ovate-elliptical ... 3. **P. tuberosa**, *Linn.*

II. Wings of the glumes irregularly and deeply toothed, the glumes acuminate or almost awned; sterile lemmas obsolete; spikelets purplish-violet. Perennials. ... ... 4. **P. caerulescens**, *Desf*

b Keels of the glumes not winged, or the wings obscure and very narrow; sterile lemmas narrow, hairy, more or less equal, less than half as long as the fertile lemma.

α. Panicle narrow-cylindrical; glumes obtuse, serrulate on the keel. Annual plant. ... ... 5. **P. angusta**, *Nees.*

β. Panicle broader, often branched or lobed; glumes acute, not serrulate on the keel. Perennial plant with creeping rhizomes ... ... 6. **P. arundinacea**, *Linn.*

B.—Spikelets of two kinds, the terminal fertile spikelet surrounded by a group of 6 (rarely fewer) sterile variously shaped spikelets which fall off entire with the terminal spikelet; fertile glumes acuminate with a dorsal more or less falcate wing; sterile lemmas minute equal. ... ... 7. **P. paradoxa**, *Linn.*

1. *Phalaris canariensis*, Linn. "Canary Grass."

An erect leafy annual of 2-4 feet in height with fibrous roots. Culms ascending or erect, branching in the lower parts; sheaths loose, shorter than the internodes, striate. Ligule membranous, truncate. Leaf-blades flat, rather broad, tapering into long fine points, striate. Panicle ovoid to ovoid-oblong, dense, the glumes

sharply keeled, flat, lanceolate, acute, prominently 3-nerved, the margins broad, thin and hyaline, the dorsal wing narrow in the lower half then gradually broadened in the upper half into a broad conspicuous wing which tapers off abruptly at the apex which is shortly acute. Sterile lemmas not very unequal, more than half as long as the fertile lemma, conspicuously nerved and somewhat keeled, appressed to the fertile lemma, scarious, glabrous or pubescent, the apex tufted with short white hairs. Fertile lemma laterally compressed, 5-nerved, silky-villous, acute, ovate to ovate-elliptical, more than half the length of the glumes; palea smooth keeled, minutely truncate and ciliate fringed.

Native to the Mediterranean Region, Northern Africa, Central Asia, and the Canary Islands.

The species may usually be distinguished by its short ovoid head. Occasionally, however, it is longer and oblong, approaching that of *P. minor*, from which it can always be distinguished by the broader wings of the glumes, broader "seeds" and the large sterile lemmas which serve to distinguish it from all other species.

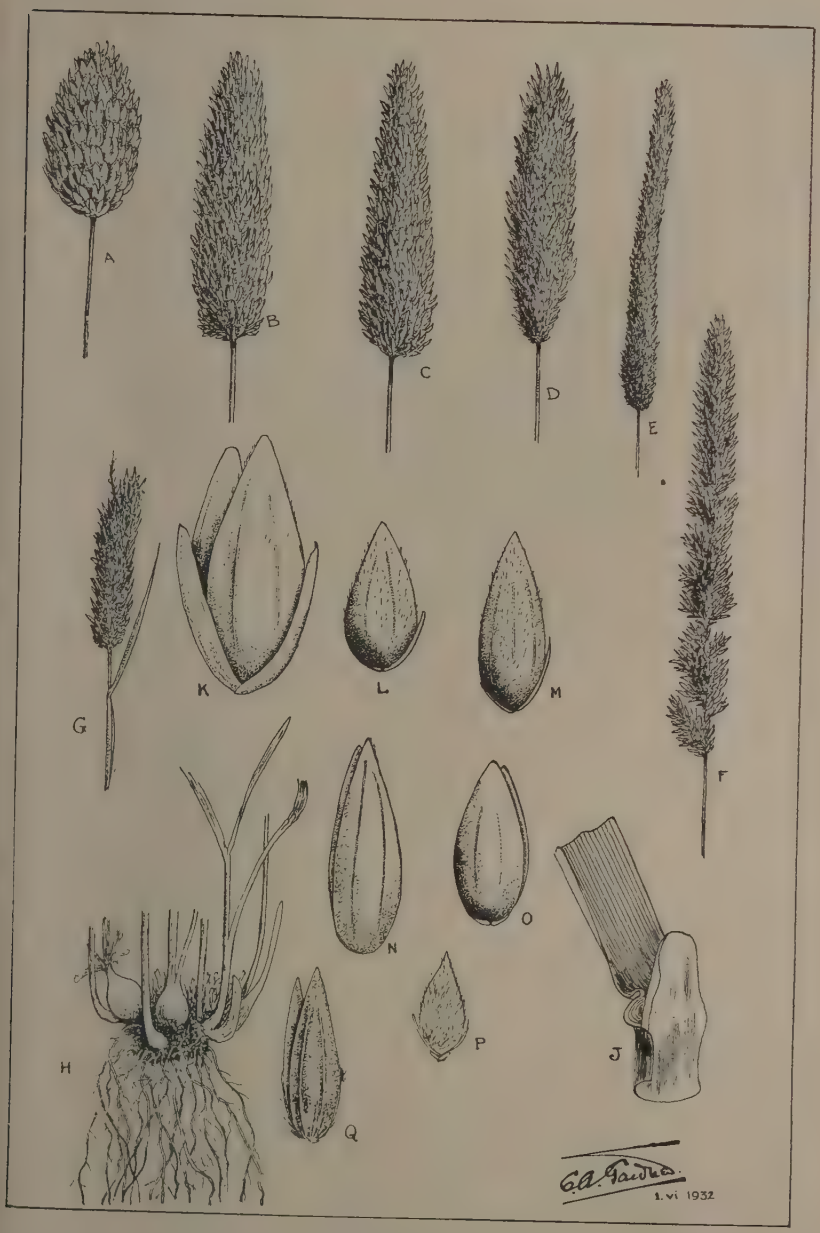
Phalaris canariensis is much cultivated in Mediterranean countries, and in Queensland, for its seed which is the Canary seed of commerce, but this usually contains also the fruits of *Panicum miliaceum*, one of the Millets. True Canary seed is light yellow in colour, about 5mm. long, ovate-elliptical in outline, laterally flattened but equally convex on both surfaces, hard, shining and pubescent, whereas the seed of *Panicum miliaceum* is pale brown or reddish, of about the same size as the former, but much more plump and distinctly flattened on one side only.

This species is naturalised in Western Australia, but is nowhere gregarious. It is met with mostly on the lighter types of soil, especially in coastal districts. Stock eat it readily when green, but it does not produce much bulk, being always erect and slender. As a crop plant it is stated to be exhaustive, and for this purpose requires a rich friable soil. The flour made from the seeds is used in certain processes of cotton manufacture.

2. *Phalaris minor*, Retz. "Lesser Canary Grass."

An erect leafy annual with fibrous roots. Culms tufted, erect or ascending, usually geniculate near the base, 1 to 3 feet in height, finely striate. Leaf-sheaths shorter than the internodes, the lower tight, the upper loose and inflated, striate. Ligule white, hyaline, delicate, up to one quarter of an inch in length. Leaf blades linear, gradually tapering into long fine points, flat, flaccid, hairless, smooth or nearly so. Panicle spikelike, oblong to cylindrical, broad, up to two and a half inches long, compact, the spikelets usually spreading, the panicle usually abrupt at the base; peduncles ultimately exserted from the sheaths. Glumes subequal, lanceolate, acute, 3-nerved, the nerves prominent, the margins broad, hyaline but firm, the dorsal wing prominent, gradually broadened from about one-third the length of the glume upwards, broadest at two-thirds of its length, then more or less gradually narrowed to the apex, minutely serrulate, and often with a few slight indentations or notches, or almost entire. Sterile lemmas reduced to an upper one which is less than half the length of the fertile lemma, linear-lanceolate, firm and sparsely hairy, closely appressed to the fertile lemma, the lower one represented by a minute callous scale, or entirely absent. Fertile lemma sparsely silky-hairy, acutely ovate about half the length of the glumes; palea obtusely acute, apparently one-nerved and more or less keeled, ciliate on the keel and minutely tufted at the apex.

Native to the Mediterranean Region but introduced into most temperate countries, and sometimes regarded as a weed. In its structure it closely resembles



PHALARIS, Linn.

PLATE I.

P. tuberosa, from which, however, it can usually be distinguished by the more acute glumes, abruptly based panicle, but more particularly by the broader fruits and the presence of only one sterile lemma. The seed is either pale yellow or brown in colour.

Phalaris minor is established widely throughout the South-West. In some localities it has been planted as *Phalaris tuberosa* in error. It is now well established as a naturalised alien as far east as Merredin, principally on the low-lying heavy clay flats subject to winter inundation. It is in such soils that it appears to make the best growth, attaining a height of 2 to 3 feet and tillering vigorously. It is a very nutritious grass, and should be worth cultivation in areas which are too dry for the maintenance of *P. tuberosa*, especially if grown with Wimmera Rye Grass. It makes good early winter growth and remains green until late into November. The species has a relatively high gluten, gum and sugar content.

3. ***Phalaris tuberosa*, Linn. (*P. bulbosa*, Linn.; *P. nodosa*, Linn.).**

Perennial, caespitose, the culms more or less swollen at the basal internodes, or forming hard woody stocks, 2-4 feet in height, erect or ascending, sometimes geniculate below. Sheaths much shorter than the upper internodes, tight and striate; ligules long, thin, white and hyaline, truncate and soon becoming lacerated. Leaf blades firm, rather soft, prominently striate, tapering into long, weak, fine points. Panicle cylindrical, spikelike, up to five and a half inches in length, compact, tapering at both ends or sometimes broader at the base, the spikelets usually erect, the peduncles ultimately long exserted.

Glumes subequal, lanceolate, rather straight, more or less acute but not long-pointed, 3-nerved, the lateral nerves prominent; margins wide, hyaline but firm, keeled, flat, the keel produced into a prominent dorsal wing extending over the upper two-thirds of the glume and gradually narrowed at each end, minutely serrulate or entire and not notched. Sterile lemmas not very unequal, the lower about one-quarter, the upper one-third the length of the fertile lemma, both sparsely hairy and appressed to the fertile lemma, more or less linear and concave. Fertile lemma acutely ovate-elliptical, silky with appressed hairs, faintly nerved, becoming firm in fruit; palea acute, slightly less in length than the fertile lemma, glabrous except for the terminal tuft of a few short hairs.

Mediterranean Region, but now introduced into many temperate countries, and known in Australia as "Toowoomba Canary Grass." This species is sometimes referred to as *P. bulbosa*, a name which is now held to be invalid, since it was applied by Linnaeus to a species of *Phleum*. Another invalid name given to the plant was *P. commutata*, a "species" which was probably described from mixed material. *Phalaris stenoptera*, a name given originally to specimens received from Victoria, is at the present time recognised by American botanists. The species is said to differ from *P. tuberosa* in the narrower wings to the glumes, the absence of the first sterile lemma (as in *P. minor*), and in the basal internodes not being swollen. An examination of the material by Stapf showed that the sterile lemmas were identical with those of *P. tuberosa*, and it has been observed locally that the swelling of the internodes is a variable character, being more pronounced in some strains than in others. The character of the breadth of the wing is not definite enough for a specific character. *Phalaris nodosa*, of which we have not seen flowering material, appears to be a narrow-leaved form of *P. tuberosa* with markedly swollen basal internodes.

Phalaris tuberosa is a grass which has proved one of the most hardy of our introduced perennial species. It was grown successfully some years ago at Kool-

herin, the property of Mr. W. N. Hedges, and in the Perth Experiment Plots carried through the summer, even producing fair growth during the driest months, in sandy soil. It is eminently suitable for places where the soil is moist throughout the summer, and under such conditions should provide abundance of feed through the year. Planted from seed it is slow in establishing itself, and for this reason if planted in a mixture, it should be grown with such species as Wild White Clover and "Cocksfoot" (*Dactylis glomerata*), or the Cocksfoot may be added during the second year. Once established, it makes vigorous growth after grazing or cutting either during the summer or the winter.

4. *Phalaris caerulescens,* Desf.

A perennial species with the habit of *P. tuberosa*: culms erect from a hard stock, 2 feet or more in height. Leaf-sheaths shorter than the internodes, tight and prominently striate. Leaves as seen, short, straight and striate; the ligule broad, white and hyaline, obtuse.

Panicle oblong-cylindrical, shortly tapering at both ends, dense, purplish-violet from the colour of the upper portions of the glumes, simple, the peduncles long exserted.

Glumes subequal, lanceolate, tapering into an acuminate almost awned apex, 3-nerved, broad and hyaline, rather firm; dorsal wing well developed, irregularly toothed or lobed, gradually broadened from about one third the length of the glume and entire for some distance above the middle, then terminating abruptly in an irregularly lobed appendage, or continuing to the apex, but always irregularly toothed or lobed in the upper part. Sterile lemmas not developed. Fertile lemma about half as long as the glumes, elliptical in outline, acute, glabrous, smooth and rather prominently nerved; palea equal to the lemma in size or slightly smaller and much narrower.

Native to the Mediterranean Region.

The species can be readily distinguished from *P. tuberosa*, to which it is most closely related, by the toothed wings of the glumes, the purplish cast of the panicle, and by the undeveloped sterile lemmas.

The species is not widely cultivated, but is at present receiving some attention.

5. *Phalaris angusta,* Nees.

An annual with fibrous roots. Culms erect, slender, straight and tall, with few nodes, prominently striate. Leaf-sheaths loose, purplish, shorter than the internodes: ligule broad and hyaline, truncate; leaf blades linear, tapering from a broad base to a long fine point, flat, smooth, many-nerved, 3-6 inches in length.

Panicle narrow, two to two and a-half inches in length, resembling that of Timothy grass (*Phleum pratense*), and about one quarter of an inch in breadth, the peduncles slender and much exceeding the uppermost leaves.

Glumes small, 3-nerved, subequal, oblong, muticous, the margins and keel parallel, the hyaline margins rather broad, the keel not winged or only obscurely so in the upper third of the glume, itself and the rudimentary wing finely toothed. Sterile lemmas linear, hairy, subequal, about half as long as the fertile lemma and closely appressed to it. Fertile lemma ovoid-elliptical, rather more than half as long as the glumes, silky-hairy; palea similar but narrower.

Native to America:—United States, Brazil, Peru and Argentine.

The species is most closely related to *P. arundinacea* with which it agrees in having the dorsal wing of the glume undeveloped. It can be distinguished from *P. arundinacea* in its smaller narrow "Timothy"-like panicle, obtuse glumes, and its

annual habit. This grass is naturalised around Bassendean in a salt swamp growing with *Calamagrostis filiformis* and *Polypogon monspeliensis* as an annual of 4 to 5 feet in height. The species should probably be found useful in swampy or sub-swampy areas where salt is present in the soil. It is very closely related to *P. carolinana*, Walt., the "Apache Timothy" of the Southern United States, a perennial which is said to be an excellent grass for winter and spring grazing.

6. ***Phalaris arundinacea*, Linn. "Reed Canary Grass."**

A perennial with short creeping rhizomes and firm scarious sheathing scales. Culms erect from a creeping or ascending base, 2-4 feet or more in height, rooting at the lower nodes, simple or scarcely branched, firm and tough, finely striate. Sheaths glabrous, smooth, strongly striate, the lower tight, the upper looser and shorter; ligule hyaline, white, obtuse, up to one-quarter of an inch in length. Leaf-blades linear to linear-lanceolate, gradually tapering into long points, 6-12 inches long, rigid, glabrous, glaucous and smooth, many nerved.

Panicle erect, sometimes nodding, spike-like or lobed, up to 8 inches in length, copiously and densely branched.

Glumes subequal, whitish green or purplish, acute, 3-nerved, lanceolate, tapering into a long acute point, the margins rather broad, the keel not winged or the wing obscure towards the apex of the glume, minutely serrulate. Sterile lemmas subequal, lanceolate to subulate, obscurely 1-nerved or nerveless, hairy with a callous base, slightly less than half as long as the fertile lemma. Fertile lemma half as long as the glumes, lanceolate in outline, dark purplish-brown, acute, sparsely silky-hairy with long hairs, palea ciliate on the back.

Mediterranean Region, Africa, Asia, and North America.

This species somewhat resembles *P. tuberosa* and *P. coerulescens*, but differs from both in its unwinged glumes and stoloniferous habit. It is structurally more closely related to *P. angusta*, an annual species, from which it can readily be distinguished by its acute glumes, broader panicle which is sometimes (not always) lobed or widely branched, and by its vegetative habit.

The Reed Canary grass is a species which thrives in shade or in wet swampy land subject to inundation, but will also grow on rather dry sandy soils where the water table is sufficiently high. The strong rhizomes creep extensively, making the grass particularly valuable for binding the banks of streams or drains. It does not attain its full development until the second year. The mature culms are somewhat woody, so that the grass should be kept well grazed, or if grown for the purpose of hay should be cut before flowering commences.

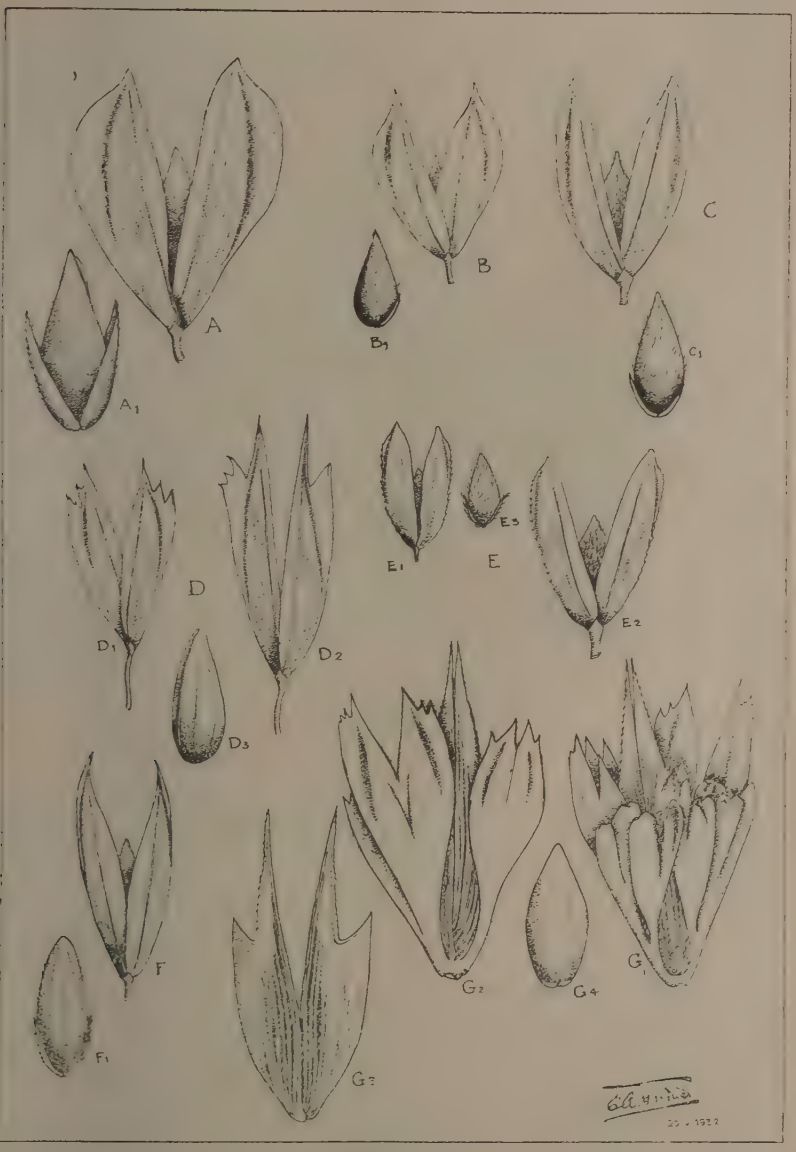
A variety of this species (var. *picta*), with leaves striped green and white, is cultivated in gardens under the name of "Ribbon grass."

7. ***Phalaris paradoxa*, Linn.**

Annual with fibrous roots; culms erect, rather slender, purplish near the nodes, striate, one to two and a-half feet in height. Leaf sheaths rather loose, the uppermost inflated; ligule long, membranous, white. Leaf-blades narrow, straight, gradually tapering to a fine point from a broad base.

Panicle cylindrical, compact, the spikelets densely crowded, the branches short and straight, the panicle narrow and about one and a-half inches in length.

Fertile spikelet terminal on the secondary branches of the panicle, surrounded by an involucre-like group of six sterile spikelets of unequal size, although two are usually much larger than the others, each consisting of complicated glumes enclosing a sterile lemma with an abortive anther, or empty. Glumes of the fertile spikelet subequal, acute or acuminate, hard, many-nerved, straight, keeled with a dorsal



PHALARIS, Linn.

PLATE II.—Details of Spikelets.

wing which terminates in a free falcate appendage slightly above the middle of the glume; margins of the glumes not hyaline. Sterile lemmas minute, scale-like, glabrous, equal in size and closely appressed to the base of the lemma. Fertile lemma smooth, almost glabrous, shining, ovate-elliptical in outline.

Mediterranean Region and the Orient.

The species is naturalised in Western Australia in the metropolitan area, but is not yet common. It is distinct from the other species enumerated by reason of its sterile spikelets which appear to fall off entire with the fertile floret, and in the straight hard glumes. It is an annual of no known economic importance.

HYBRIDISM.

There appears to be some evidence that hybridisation occurs under conditions of cultivation between *Phalaris minor* and *P. tuberosa*. Few, if any, of the commercial samples of seeds of "Toowoomba Canary Grass" are pure *P. tuberosa*, and the majority would seem to be closer to what Hackel called *P. stenoptera*. Assuming (as we must) that *Phalaris tuberosa* has the two sterile lemmas developed and that *P. minor* has only the upper sterile lemma developed, then some, or the majority of the commercial seed resembles that of *P. minor* with a narrower floret, and the plants are perennial in habit. We notice that the strains of Toowoomba Canary Grass under cultivation locally vary considerably in the production of the internodal swellings which are a feature of *P. tuberosa*. In other words, much of the Toowoomba Canary Grass is identical with Hackel's *Phalaris stenoptera*, but rather than regard this as a valid species it is better to regard *P. stenoptera* as typical of the *P. tuberosa-P. minor* hybrid, and not as a synonym for *P. tuberosa*, Linn.

In dealing with this hybrid form which occurs so freely in commercial samples of "P. tuberosa" seed, the character of the lower sterile lemma is of no importance, and the only reliable test between such seed and that of *P. minor* is the germination test referred to below.

The above condition would account for the statement of Ewart in the "Flora of Victoria," p. 135, "Apparently pure seed (of *P. stenoptera*) often appears to produce seedlings of *P. minor* and *P. bulbosa*."

COMMERCIAL SEEDS.

Some difficulty has been experienced in obtaining indubitable seed of "*Phalaris tuberosa*" of reasonable purity, this being usually adulterated with seeds of *P. minor*, an annual species which it is undesirable to incorporate in perennial pastures. The difference in price between the seeds of the two species also makes such adulteration undesirable. The seeds of both species vary in colour from a pale to a dark brown, but usually may be separated on their shape and the form of the sterile florets. In the case of machine dressed seeds the sterile florets are usually damaged, thus making the shape the main superficial feature for distinguishing them. The seed of "*P. tuberosa*" has an average length and breadth of 3.25mm. and 1.25mm. respectively and is rather narrow-ovate-elliptical gradually tapering to a point. In comparison, the seed of *P. minor* is broadly ovate-elliptical, rather more abruptly narrowed to a point, with an average length of 2.75mm. and breadth of 1.25mm.

A certain amount of variation in shape occurs, and difficulty is sometimes experienced in distinguishing between narrow seeds of *P. minor* and small seeds of "*P. tuberosa*," particularly after machine dressing has damaged the sterile florets. In such cases where determination by means of external characters is unsuccessful, the seeds of the two species may be separated by means of a germination test carried out on damp blotting paper. The roots, and more particularly the root caps of *P. minor* seedlings show a reddish colour, while those of "*P. tuberosa*" are a greenish-white. By a simple count with a given number (say 100) seeds the approximate percentage of "*P. tuberosa*" may be estimated.

It is evident that samples of "*P. tuberosa*," containing impurities of the annual species, or even consisting entirely of them as sometimes is the case, have had a considerable effect in retarding the development of Toowoomba Canary Grass. Farmers buying the seed as a perennial species, and finding that the plants die out during the first season (due to such impurities) naturally consider the Toowoomba Canary Grass unsuitable for their district. To quote an example: an introduced line of seeds from overseas received as *P. tuberosa* was planted in the local experimental plot. Upon flowering it was determined as *P. minor* and died out towards the end of November. Although a good sample of the annual species, this seed would have been useless—in fact detrimental—in a permanent pasture seed mixture for which purpose the bulk was probably used.

"*Phalaris tuberosa*" is not a heavy seed producer, and this, together with the considerable demand made on the comparatively few producers, has made the seed expensive. By careful collecting in a reasonably pure crop, seeds of 95 per cent. purity can be obtained. Usually the germination is comparatively low, probably due to irregular ripening of the seeds within the heads, so that a sample giving a germination of 60 per cent. must be considered quite good. As with most other commercial seeds, even if the above conditions are fulfilled, care should be taken to select a reliable strain, since even within the species there is a variation in leaf production, permanence and other features affecting the value of the grass. This difficulty is best overcome by buying from a reliable seedsman or producer. A system of Government certification of "*P. tuberosa*" seed would simplify the buying of seed, and generally assist the establishment of this grass.

Little seed of *P. minor* and *P. canariensis* is sold for agricultural purposes, and as yet the other species mentioned in this paper are in their early experimental stages locally.

EXPLANATION OF PLATES.

PLATE I.

A.—G. Diagrams of panicles (reduced in size).

A. *Phalaris canariensis*, Linn. B. *P. minor*, Retz. C. *P. tuberosa*, Linn. D. *P. caerulescens*, Desf. E. *P. angusta*, Nees. F. *P. arundinacea*, Linn. G. *P. paradoxa*, Linn. H. Diagram illustrating the growth of *P. tuberosa*, showing the internodial swellings—the "tubers." J. Diagram of the ligule of *Phalaris*.

K.—Q. Drawings of fruits (magnified eight times).

K. *P. canariensis*. L. *P. minor*. M. *P. tuberosa*. N. *P. caerulescens*. O. *P. paradoxa*. P. *P. angusta*. Q. *P. arundinacea*.

PLATE II.

Spikelets and fruits ("seeds").

(The numbers following the letters refer to florets.)

A. *P. canariensis*, Linn. Haywood, Staffordshire, England. P. P. Thornton, Aug., 1924.

B. *P. minor*, Retz. Merredin, W.A. W. M. Carne, 1924.

C. *P. tuberosa*, Linn. Earnsileugh, Otago, New Zealand, H. H. Allen.

D. *P. caerulescens*, Desf. S. Juan de Alcaras, Spain. E. Bourgeau, July, 1850.

E. *P. angusta*, Nees. Bassendean, W.A. C. B. Palmer, Nov., 1929. (E2 is again enlarged from E1.)

F. *P. arundinacea*, Linn. Glumes from Hitchcock's Text Book of Grasses; fruit from "Canary Grasses of New Zealand," Allen & Zotov.

G. *P. paradoxa*, Linn. Bassendean, W.A. C. B. Palmer, Oct., 1928.

The fruit of Phalaris arundinacea in Plate I. is drawn from seed received from the Waite Research Institute, South Australia.

The fruits and glumes of *P. tuberosa* are drawn from New Zealand specimens, and although apparently typical, may not be true *P. tuberosa*.

Icon. origin.

BROWN ROT OF CITRUS.

A SERIOUS DISEASE THAT CAN BE EASILY PREVENTED.

H. A. PITTMAN, B.Sc.Agr., Plant Pathologist.

There are two forms of "Brown Rot" present in this State on *Citrus spp.* (1, 2, 3),* one of which, due to the fungus *Phytophthora hibernalis*, Carne, occurs mainly during the cold wet weather of the winter; while the other, caused by *Phytophthora* (*Pythiacystis*) *citrophthora* (Smith and Smith), Leonian, causes losses during the warm moist weather of the late autumn or spring. While at one time the cold weather disease apparently dominated the situation in this State and the warm weather organism was little, if at all, heard of (1, 2, 3),* the warm weather disease, known for sake of clarity as the "Californian" Brown Rot, has become of very considerable importance, especially on lemons, during the past two years.

During October, 1930, almost complete defoliation of lemon trees was caused by *Phytophthora citrophthora* in a number of localities on the Coastal Plain and in the Darling Range. Unwarned by this occurrence, many neighbouring orchardists lost almost their complete crop of lemon fruits and leaves in the spring of 1931 on account of the ravages of the "Californian" disease. When asked why they had not sprayed their trees in the autumn as a routine precautionary measure against "Brown Rot," many replied that they had come to regard the "usual" form of "Brown Rot" as of little consequence in ordinary years, provided the lower branches were kept well pruned up off the ground. A little fruit would always be spoiled and more or less foliage lost, but "nothing to worry about."

Such an attitude is incomprehensible to the writer, who regards preventive spraying of citrus trees in this State as just as much a routine part of the process of growing them as manuring or cultivation.

SYMPTOMS OF THE DISEASE—GENERAL CONSIDERATIONS.

The "Californian" Brown Rot as it occurs in this State agrees with American experience in that it is essentially a disease of lemon leaves and fruit. Orange and mandarin trees growing amongst almost entirely defoliated and defruited lemon trees are usually comparatively little affected. On the other hand the "Australian" form attacks oranges and mandarins more frequently than lemons. Other varieties of citrus than those already mentioned are only grown to a very small extent in this State, and no observations have been made concerning their susceptibility to attack by either parasite.

Both forms occur very much more seriously on very heavy clay soil with a high moisture content than on lighter and better drained soils. Lemon trees growing on very sandy soil frequently show hardly any trace of Brown Rot, whereas similar trees on heavy soil a short distance away on the same orchard may, at the same period, be almost completely defoliated and have most of the fruit affected.

The symptoms shown by affected fruits and leaves are very much the same on matter by which of the parasites the disease is caused.

FRUIT SYMPTOMS.

Affected orange and mandarin fruits develop a dull brown area, usually on one side, which spreads outwards from the original point of infection in a more or less circular fashion until the whole fruit may be involved. The affected areas

* See references to literature cited at end of article.

remain firm to the touch unless secondary organisms have gained entry. Orange, lemon, and mandarin fruits affected with brown rot are accompanied by a very penetrating and characteristic odour, quite distinct from the odours produced in rotting citrus fruits by such organisms as "Blue Mould," *Penicillium spp.*, or the "Sour Rot" fungus, *Oospora citri-aurantii.*

If free from secondary organisms, the affected areas become dark brown, dry, and eventually sunken; the whole fruit finally shrinking to a hard, dry mummy. This, of course, usually only occurs when the fruits are kept in a dry place. In the orchard, however, where the infected fruits are frequently moistened by rain or dew, secondary organisms almost invariably invade the "Brown Rotted" fruits and prevent mummification.

During wet conditions in the orchard, or when placed in a moist jar, a whitish growth of fungal threads (*mycelium*) develops on and around the lesions. Where fruits are borne in bunches and one or more is obviously affected with "Brown Rot," the apparently sound fruits growing in contact with the diseased are generally also infected. The first-infected fruits and leaves are generally those in contact with, or close to the soil, but later on infected fruits and leaves may be found at any position in the tree, due to the flicking of *spores* (fungus-seeds) in drops of moisture by the movement of the branches to higher parts of the same or neighbouring trees. In general, however, the disease is progressively less abundant towards the top of the tree.

Affected lemon fruits develop a washed-out, tightly-drawn, pale yellow or almost white colour on the diseased areas, showing in marked contrast to the brighter yellow of the sound skin. A pink or reddish stain may mark the point of infection in the case of the "Californian" form, but has not been observed with the "Australian" disease. The affected areas eventually turn brown. In the rare absence of secondary infection, diseased fruits shrink and dry.

LEAF SYMPTOMS.

Affected leaves of lemons, oranges, and mandarins develop dark-coloured, water-soaked areas, usually at the tips, but sometimes at the edges, or occasionally located in the middle of a leaf. Diseased leaves curl up towards the tips and characteristically fall very readily while still green and healthy-looking over the greater part of their surfaces. The falling of the leaves is one of the most obvious signs of the presence of the disease in the early stages. Affected leaves which remain attached to the tree eventually become brown in colour over the affected areas.

Leaf and fruit infections tend to be more common on the sides of the trees sheltered to some extent from the sun and wind, *i.e.*, on those parts of the tree which remain moist longest after rain. In densely foliaged trees the disease sometimes works in a funnel-like manner from the bottom to the top of the tree, leaving an outer zone of leaves and fruit unaffected.

CONTROL.

1. The winter form of Brown Rot can be very readily prevented in this State by spraying the lower two-thirds of the tree in the autumn, say at the middle to the end of April, before the autumn rains commence, with home-made Bordeaux mixture, 5-5-50, or, if preferred, with commercial ready-mixed so-called "Bordeaux" powders, at the rate of one pound to five gallons of water.* To ensure the

* True "Bordeaux" mixtures are those in which the bluestone is neutralized with lime; those in which the neutralizing is done with soda should more properly be known as "Burgundy" mixtures. Generally speaking, these latter are more caustic than the former.

maximum possible protection, ½ lb. of calcium caseinate spreader should be added to each 50 gallons of spray. In mixing the spreader, make the required amount of calcium caseinate into a paste in a billycan, jug, or other suitable receptacle by putting the caseinate into the dry container and then adding as much water by volume as there is caseinate. Stir, so as to form a thin paste (just in the same way as powdered skim milk is mixed by the experienced housewife for human use) and, when made into a paste, dilute with water and add to the mixture in the spray tank, keeping the agitator going during the process.

The trunks of the trees should be well drenched with the spray as a precautionary measure against "Brown Rot gummosis," which has been found on the trunks of citrus trees, especially lemons, in several orchards in this State on very heavy moist soils.

2. To guard against further infection in the spring by the "Californian" organism, spray the lower two-thirds of the trees with Bordeaux 5-5-50 in late winter or very early spring, say in the first or second week of August.

If more than the lower two-thirds of each tree is sprayed, a serious increase in the number of scale insects is likely to occur, owing to the killing off, by the Bordeaux mixture, of the beneficial fungi which parasitise the scale insects and help to keep them in check.

When spraying the trees, the soil below, and also in between the trees, should be sprayed with the Bordeaux, as infection carries over from one year to another in diseased tissues in the soil. Moreover, quite apart from its fungicidal value, Bordeaux mixture has a tonic effect on the growth of citrus trees; crushed bluestone up to 2 or 3 pounds weight per tree being applied annually to the soil in certain cases to prevent or cure the physiological die-back and gumming disease known as "Exanthema." (See Department of Agriculture Leaflet 176, 2nd edition.)

If spraying is delayed until the disease is already well established, the disease will continue to show up on a further lot of leaves and fruit for about ten days or a fortnight after spraying, as the spraying is a preventive, not a cure; so that any infection which has taken place just prior to spraying must run its course, quite irrespective of the fact that a deposit of poisonous material is covering the outside of the recently-invaded tissues.

Leaflet No. 314, which gives simple directions for the preparation of Bordeaux mixture in either small or large quantities, is obtainable, free of charge, upon application to the Department of Agriculture. A full account of the preparation of this excellent fungicide can also be found on pages 600-609 of the December, 1930, issue of the "Agricultural Journal." Growers are especially advised to make use of stock solutions of bluestone and of lime, as therein advised, to simplify the process of making the Bordeaux. The directions should be followed very closely, and growers should be particularly careful only to use the very best freshly-burnt or "quick" lime. Air-slaked lime is useless for the preparation of Bordeaux mixture. A rough but useful test which should always be made after the Bordeaux mixture has been prepared, and before spraying the plants with it, is to dip the clean blade of a penknife or a bright piece of iron, such as a shiny nail, into the mixture for several minutes. If the mixture does not contain enough lime, a reddish-brown deposit of copper will form on the iron and more lime will need to be added, until, on further testing with a fresh knife blade or shiny nail, no stain is obtained. If this test is always carried out before spraying with the Bordeaux mixture, there need be no fear of burning citrus plants with the spray.

3. In addition to spraying in the autumn and early spring with Bordeaux mixture, the control of this disease will be facilitated if any excess branches are thinned out so as to allow plenty of light and air into the centre of the tree to dry up the moisture as rapidly as possible after rain or dew, etc.

4. Any very low-hanging branches which tend to drag on the ground in the wind or when weighed down by fruit or by rain should be pruned back so as to leave at least a foot of clear space above the ground all round the tree. This will allow greater freedom of air and light movement and will facilitate the drying of the leaves and fruit after rain or dews, etc. *Phytophthora spp.* are water-loving organisms, and it is only in the presence of abundance of moisture that they can infect the plant tissues.

5. For the reason just indicated, the drainage, if defective, should be improved.

6. Should the spraying not have been done early enough to prevent the disease establishing itself, spraying should be carried out at the earliest opportunity, *i.e.*, during the earliest fine bright weather.

7. All diseased fruits should be gathered up and destroyed by boiling or burying in a deep hole well away from the site of the orchard, and where there will be no danger of flood waters unearthing them and spreading them around the countryside.

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CLOVER SPRINGTAIL (LUCERNE FLEA) (*Smynthuris viridis*) INVESTIGATION.

By

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and

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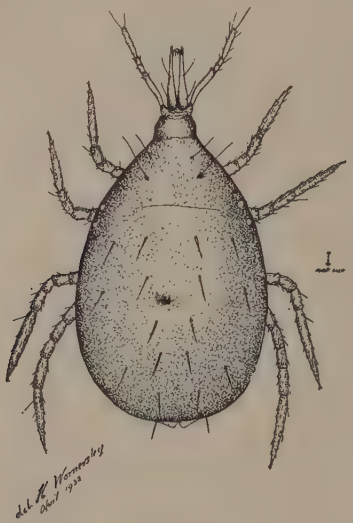
One of the results of this investigation has led to the discovery of a predatory mite which gives promise of considerable natural control of the Clover Springtail.

This predator is one of the Snout Mites (*Bdillidae*), in particular a species known as *Biscirus lapidarius* (Kramer). This discovery was made as a result of considerable research in the field in various parts of the flea-infested areas.

This predator is now known to occur at Waroona, Burekup, and Denmark. In each of these places there is considerable evidence of its utility as a controlling factor.

With the object of further assisting this work, the co-operation of all farmers is desired on the following lines: Wherever the flea was at one time prevalent and is now known to be definitely on the decrease, search should be made for this predator, and at the same time this information forwarded to this Department. If such conditions are found, it is inadvisable to adopt any artificial treatment owing to the risk of destroying the beneficial creature. Before such determination is arrived at, however, examples of the supposed predator should be submitted to the Department of Agriculture for definite determination.



Biscirus lapidarius (Kramer).

One of the Snout-mites (*Bdellidae*), predatory on the Clover Springtail (*Sminthurus viridis*).

Description.

This predator is a small light reddish to dark red mite, which runs about actively in close proximity to the surface of the ground amongst the clovers and other pasture plants. It can be recognised by the presence of a long snout (see illustration), eight legs, and two long feelers (palps).

It has a habit of hiding, particularly during warm, dry spells, under pieces of bark, slats of wood, or other suitable cover. When the identity of the mite is definitely established, it can be distributed to other parts of the infested area by transferring the slabs of wood or other shelter to which it is clinging. By taking this action, the beneficial mite can be greatly assisted in its welcome spread.

FERTILISERS.

N. Davenport, Inspector of Fertilisers.

The Fertilisers Act, 1928, provides that a list of the fertilisers registered for each current fertiliser year may be published, and the appended table shows all registrations up to 31st May of this year.

The unit values computed from the prices of these fertilisers are listed below, as are also those for 1931 for comparison.

The greatest reduction in unit values is that for nitrogen in organic fertilisers such as bonedust, blood and bone, etc. In this case a fall of from 32s. to 24s. per unit has occurred, equal to 25 per cent.

There is little variation shown in the prices of water, citrate and acid soluble phosphoric acid units, the only revision being the raising of the water and citrate soluble forms by 1d. per unit.

The price of nitrogen, as sulphate of ammonia, has dropped 2d. per unit to 12s. 6d., but there is still a considerable difference from the English price of 5s. 4d. per unit.

There has been a marked increase of both forms of potash, viz., sulphate and muriate, principally due to varying exchange rates between the Continent and London and Australia, combined with depreciation of sterling and increased production costs.

UNIT VALUES.

	1931.		1932.
	s. d.		s. d.
NITROGEN (N).			
As blood and bone, bonedust, and bone and flesh ...	32 0	...	24 0
,, nitrate	20 0	...	20 3
,, ammonia	12 8	...	12 6
PHOSPHORIC ACID (P_2O_5).			
As water soluble	4 1	...	4 2
,, citrate soluble	4 1	...	4 2
,, acid soluble :—			
in bonedust	...	...	6 6
in blood and bone and other animal fertilisers	6 6	...	5 6
in basic phosphate	...	...	5 6
in superphosphate and rock phosphate ...	2 6	...	2 6
POTASH (K_2O.)			
As sulphate	6 0	...	7 4
,, muriate	4 11	...	5 8

FERTILISERS.

The following fertilisers have been registered at the Department of Agriculture, under the Fertilisers Act, for the year commenced 1st November, 1931:—

Name of Fertiliser.	Firm.	Brand.	Fertilising Ingredients.										Price per ton on rails at works or Perth.
			Nitrogen (N) as				Phosphoric Acid (P_2O_5) as				Potash (K_2O).		
			Nitrate.	Ammonia.	Blood and Bone.	Bone.	Water sol.	Citrate sol.	Acid sol.	Total.	Sulphate.	Muriate.	
A.—MINERAL.													
1. NITROGENOUS:			%	%	%	%	%	%	%	%	%	%	£ s. d.
(a) Nitrogen as Nitrate:													
Nitrate of Soda ...	Cuming Smith, Mt. Lyell F.F., Ltd.	Sickle	15·5	...	...	...	...	...	...	...	...	...	15 4 0
Do.	do.	do. ML (in diamond)	15·5	...	...	...	...	...	...	...	...	...	15 4 0
Do.	do.	do. CSML	15·5	...	...	...	...	...	...	...	...	...	15 4 0
Do.	Cresco Fert. (W.A.), Ltd.	Cresco	15·0	...	...	...	...	...	...	...	...	...	16 10 0
Nitrate of Lime ...	do.	do.	15·5	...	...	...	...	...	...	...	...	...	16 0 0
(b) Nitrogen as Ammonia:													
Sulp. Ammonia ...	Cuming Smith, Mt. Lyell	Sickle	...	20·5	...	...	...	...	...	...	...	...	12 15 0
Do.	do.	do. ML (in diamond)	...	20·5	...	...	...	...	...	...	...	...	12 15 0
Do.	do.	do. CSML	...	20·5	...	...	...	...	...	...	...	...	12 15 0
Do.	Cresco Fert. (W.A.), Ltd.	Cresco	...	20·0	...	...	...	...	...	...	...	...	12 15 0
Do.	F. Viles	1C1 (in circle) ...	...	20·6	...	...	...	...	...	...	...	...	12 15 0
2. PHOSPHATIC:													
(a) Rock Phosphates:													
Pacific Islands Phosphate	Cuming Smith, Mt. Lyell	Sickle	...	...	...	...	...	...	36·65	36·65	...	...	4 11 6
Do.	do.	do. ML (in diamond)	...	...	...	...	...	...	36·65	36·65	...	...	4 11 6
Do.	do.	do. CSML	...	...	...	...	...	...	36·65	36·65	...	...	4 11 6
Phosphate Powder ...	Cresco Fert. (W.A.), Ltd..	Cresco	...	...	...	...	...	...	34·80	34·80	...	...	4 10 0
(b) Superphosphates:													
Florida Super, 22 per cent.	Cuming Smith, Mt. Lyell	Sickle	...	...	...	...	20·5	·5	1·0	22·0	...	...	4 10 0
Mt. Lyell Super, 22 per cent.	do.	do. ML (in diamond)	...	...	...	...	20·5	·5	1·0	22·0	...	...	4 10 0
Superphosphate, 22 per cent.	do.	do. CSML	...	...	...	...	20·5	·5	1·0	22·0	...	...	4 10 0
22 Super.	Cresco Fert. (W.A.), Ltd.	Cresco	...	...	...	...	20·5	·5	1·0	22·0	...	...	4 15 0
Florida Super., 24 per cent.	Cuming Smith, Mt. Lyell	Sickle	...	...	...	...	22·0	·5	1·5	24·0	...	...	4 15 0
Mt. Lyell Super., 24 per cent.	do.	do. ML (in diamond)	...	...	...	...	22·0	·5	1·5	24·0	...	...	4 15 0
Superphosphate, 24 per	do.	do. CSML	...	...	...	...	22·0	·5	1·5	24·0	...	...	4 15 0
24 Super.	Cresco Fert. (W.A.), Ltd.	Cresco	...	...	...	...	22·0	·5	1·5	24·0	...	...	5 0 0
46 Super.	do.	do.	...	...	...	...	46·0	...	...	46·0	...	...	11 5 0
(c) Rock Phosphates and Superphosphates:													
Phosphate Mixture, 50/50	Cuming Smith, Mt. Lyell	Sickle	..	...	...	...	10·0	1·0	18·0	29·0	..	..	4 11 6

Do.	do.	do.	ML (in diamond)	...	...	...	...	10·0	1·0	18·0	29·0	...	...	4 11 6
Do.	do.	do.	CSML	...	...	...	...	10·0	1·0	18·0	29·0	...	...	4 11 6
50/50 Phosphate ...	Cresco Fert. (W.A.), Ltd.		Cresco	...	...	...	...	9·16	1·84	17·40	28·40	...	...	5 0 0
(d) Basic Phosphates :														
Basic Phosphate ...	Cuming Smith, Mt. Lyell		Sickle	...	...	...	...	...	...	17·0	17·0	...	...	4 14 0
Do.	do.	do.	ML (in diamond)	...	...	...	...	...	...	17·0	17·0	...	...	4 14 0
Do.	do.	do.	CSML	...	...	...	...	...	...	17·0	17·0	...	...	4 14 0
3.—POTASSIC :														
(a) Potash as Sulphate :														
Sulphate of Potash ...	do.	do.	Sickle	...	...	...	...	...	...	...	...	48·6	...	17 11 6
Do.	do.	do.	ML (in diamond)	...	...	...	...	...	...	...	...	48·6	...	17 11 6
Do.	do.	do.	CSML	...	...	...	...	...	...	...	...	48·6	...	17 11 6
Do.	Cresco Fert. (W.A.), Ltd.		Cresco	...	...	...	...	...	...	...	...	48·5	...	18 0 0
Do.	Pacific Potash, Ltd. ...		Sun (and diagram)	...	...	...	...	...	...	...	...	48·6	...	18 0 0
(b) Potash as Muriate :														
Muriate of Potash ...	Cuming Smith, Mt. Lyell		Sickle	...	...	...	...	...	...	...	...	...	50·0	14 1 6
Do.	do.	do.	ML (in diamond)	...	...	...	...	...	...	...	...	...	50·0	14 1 6
Do.	do.	do.	CSML	...	...	...	...	...	...	...	...	...	50·0	14 1 6
Do.	Cresco Fert. (W.A.), Ltd.		Cresco	...	...	...	...	...	...	...	...	...	50·0	14 10 0
Do.	Pacific Potash, Ltd. ...		Sun (with diagram)	...	...	...	...	...	...	...	...	...	50·0	14 10 0
Kainit	do.	do.	do.	...	...	...	...	...	...	...	...	...	14·0	*
Potash Manure Salts ...	do.	do.	do.	...	...	...	...	...	...	...	...	...	30·0	8 10 0
30 per cent. Potash salts	Cresco Fert. (W.A.), Ltd.		Cresco	...	...	...	...	...	...	...	...	...	30·0	8 10 0
4.—NITROGEN AND PHOSPHORIC ACID :														
Ammonia and Phosphate	Cresco Fert. (W.A.), Ltd.		do.	...	2·0	...	...	8·3	1·6	15·7	25·6	...	...	6 5 0
Ammonia and Phosphate, No. 2	do.	do.	do.	...	3·5	...	...	15·0	·4	1·6	17·0	...	...	7 2 6
Super and Ammonia ...	do.	do.	do.	...	5·0	...	...	15·37	...	1·13	16·5	...	...	7 2 6
Super and Ammon., No. 1	Cuming Smith, Mt. Lyell		Sickle	...	1·5	...	...	16·0	·4	2·1	18·5	...	...	5 9 0
Do. ... No. 1	do.	do.	ML (in diamond)	...	1·5	...	...	16·0	·4	2·1	18·5	...	...	5 9 0
Do. ... No. 1	do.	do.	CSML	...	1·5	...	...	16·0	·4	2·1	18·5	...	...	5 9 0
Do. ... No. 2	do.	do.	Sickle	...	3·5	...	...	15·0	·4	1·6	17·0	...	...	6 14 0
Do. ... No. 2	do.	do.	ML (in diamond)	...	3·5	...	...	15·0	·4	1·6	17·0	...	...	6 14 0
Do. ... No. 2	do.	do.	CSML	...	3·5	...	...	15·0	·4	1·6	17·0	...	...	6 14 0
Do. ... No. 3	do.	do.	Sickle	...	6·0	...	...	13·5	·4	1·6	15·5	...	...	7 14 0
Do. ... No. 3	do.	do.	ML (in diamond)	...	6·0	...	...	13·5	·4	1·6	15·5	...	...	7 14 0
Do. ... No. 3	do.	do.	CSML	...	6·0	...	...	13·5	·4	1·6	15·5	...	...	7 14 0
No. 2, Potato	do.	do.	ML (in diamond)	...	3·5	...	...	15·0	·4	1·6	17·0	...	...	6 14 0
Special Potato Manure C	do.	do.	Sickle	...	3·5	...	...	15·0	·4	1·6	17·0	...	...	6 14 0
Do. do.	do.	do.	CSML	...	3·5	...	...	15·0	·4	1·6	17·0	...	...	6 14 0
No. 6, Potato	do.	do.	ML (in diamond)	...	6·0	...	...	13·5	·4	1·6	15·5	...	...	7 14 0
Special Potato Manure F	do.	do.	Sickle	...	6·0	...	...	13·5	·4	1·6	15·5	...	...	7 14 0
Do. do.	do.	do.	CSML	...	6·0	...	...	13·5	·4	1·6	15·5	...	...	7 14 0
Potato Fertiliser X ...	Binney & Son		Swan	...	3·2	...	...	10·25	...	1·09	11·34	...	...	7 7 6
Do. do.	D. F. Carbarns & Co. ...		Crown	...	3·2	...	...	10·25	...	1·09	11·34	...	...	7 7 6
Potato Fertiliser C ...	A. Richards		Vigor	...	3·2	...	...	10·25	...	1·09	11·34	...	...	7 7 6

FERTILISERS—*continued.*

Name of Fertiliser.	Firm.	Brand.	Fertilising Ingredients.										Price per ton on rails at works or Perth.
			Nitrogen (N) as				Phosphoric Acid (P_2O_5) as				Potash (K_2O). as		
			Nitrate.	Ammonia.	Blood and Bone.	Bone.	Water sol.	Citrate sol.	Acid sol.	Total.	Sulphate.	Muriate.	
5.—NITROGEN, PHOSPHORIC ACID AND POTASH:			%	%	%	%	%	%	%	%	%	%	£ s. d.
No. 3 Potato	Cuming Smith, Mt. Lyell	ML (in diamond)	...	3·75	...	...	14·50	·35	·75	15·6	4·5	...	7 19 0
Special Potato Manure B	do. do.	Sickle	...	3·75	...	...	14·50	·35	·75	15·6	4·5	...	7 19 0
Do. do.	do. do.	CSML	...	3·75	...	...	14·50	·35	·75	15·6	4·5	...	7 19 0
No. 4, Potato	do. do.	ML (in diamond)	...	3·5	...	...	14·0	·3	·7	15·0	8·0	...	8 16 6
Special Potato Manure E	do. do.	Sickle	...	3·5	...	...	14·0	·3	·7	15·0	8·0	...	8 16 6
Do. do.	do. do.	CSML	...	3·5	...	...	14·0	·3	·7	15·0	8·0	...	8 16 6
No. 7, Potato	do. do.	ML (in diamond)	...	3·5	...	...	10·5	·2	·6	11·3	16·0	...	10 6 6
Special Potato Manure G	do. do.	Sickle	...	3·5	...	...	10·5	·2	6	11·3	16·0	...	10 6 6
Do. do.	do. do.	CSML	...	3·5	...	...	10·5	·2	·6	11·3	16·0	...	10 6 6
No. 8, Potato	do. do.	ML (in diamond)	...	4·0	...	...	12·7	·3	·7	13·7	9·0	...	9 1 6
Special Potato Manure H	do. do.	Sickle	...	4·0	...	...	12·7	·3	·7	13·7	9·0	...	9 1 6
Do. do.	do. do.	CSML	...	4·0	...	...	12·7	·3	·7	13·7	9·0	...	9 1 6
Special Potato Fertiliser	do. do.	Sickle	...	7·5	...	...	7·0	·2	·4	7·6	13·25	...	11 9 0
Do. do.	do. do.	ML (in diamond)	...	7·5	...	...	7·0	·2	·4	7·6	13·25	...	11 9 0
Do. do.	do. do.	CSML	...	7·5	...	...	7·0	·2	·4	7·6	13·25	...	11 9 0
Potato Special	Cresco Fert. (W.A.). Ltd.	Cresco	...	4·0	...	...	12·5	·5	·75	13·75	8·75	...	9 15 0
Potato Manure	do. do.	do.	...	1·5	...	...	7·1	1·4	13·5	22·0	7·5	...	7 12 6
Potato Manure No. 2 ...	do. do.	do.	...	8·2	...	...	8·2	...	...	8·2	...	10·0	11 0 0
Mixed Manure	do. do.	do.	...	1·5	...	...	7·1	1·4	13·5	22·0	7·5	...	7 12 6
Mixed Manure, No. 2 ...	do. do.	do.	...	2·0	...	...	16·5	...	1·0	17·5	5·0	...	7 12 6
Do. No. 3 ...	do. do.	do.	...	3·0	...	...	14·0	...	...	14·0	6·0	...	8 15 0
Potato Fertiliser ...	Binney & Son	Swan	...	3·2	...	...	10·25	...	2·0	12·25	4·0	...	8 12 6
Do.	D. F. Carbarns & Co. ...	Crown	...	3·2	...	...	10·25	...	2·0	12·25	4·0	...	8 12 6
Special Mixture K ...	Cuming Smith, Mt. Lyell	Sickle	...	8·34	...	...	8·4	·2	·4	9·0	...	10·04	10 6 6
Do. K ...	do. do.	ML (in diamond)	...	8·34	...	...	8·4	·2	·4	9·0	...	10·04	10 6 6
Do. K ...	do. do.	CSML	...	8·34	...	...	8·4	·2	·4	9·0	...	10·04	10 6 6
Orchard Manure ...	do. do.	Sickle	...	2·0	...	...	14·0	·4	1·6	16·0	...	5·0	6 19 0
Do.	do. do.	ML (in diamond)	...	2·0	...	...	14·0	·4	1·6	16·0	...	5·0	6 19 0
Do.	do. do.	CSML	...	2·0	...	...	14·0	·4	1·6	16·0	...	5·0	6 19 0
Do.	Cresco Fert. (W.A.), Ltd.	Cresco	...	1·5	...	...	7·1	1·4	13·5	22·0	7·5	...	7 12 6
Tobacco Manure ...	do. do.	do.	...	3·3†	...	...	14·2	...	1·3	15·5	5·6	...	8 7 6
Tobacco Fertiliser ...	Cuming Smith, Mt. Lyell	Sickle	...	3·3†	...	...	14·0	·5	1·0	15·5	5·7	...	8 2 6
Do. do.	do. do.	ML (in diamond)	...	3·3†	...	...	14·0	·5	1·0	15·5	5·7	...	8 2 6
Do. do.	do. do.	CSML	...	3·3†	...	...	14·0	·5	1·0	15·5	5·7	...	8 2 6
Vine Manure	Cresco Fert. (W.A.), Ltd.	Cresco	...	1·5	...	...	7·1	1·4	13·5	22·0	7·5	...	7 12 6
Rose Food	Sunnyside Products ...	Sunnyside	...	3·5	...	...	7·3	...	2·3	9·6	6·8	...	12 2 6‡
Orchard Fertiliser No. 1	Binney & Son	Swan	...	8·25	...	...	8·05	·61	...	8·66	...	10·0	
Do. ... No. 3	do.	do.	...	2·0	...	...	...	...	16·0	16·0	...	5·0	7 7 6

6.—MISCELLANEOUS:														
Super and Manganese ...	Cresco Fert. (W.A.), Ltd.	Cresco	§	...	...	...	17·0	·5	1·0	18·5	...	...	7 15 0	
Crushed Sulphur ...	Cuming Smith, Mt. Lyell	Sickle	...	...	...	...	...	...	...	...	...	...	15 4 0	
Do.	do. do.	ML (in diamond)	...	...	...	...	...	...	...	...	...	...	15 4 0	
Do.	do. do.	CSML	...	...	...	...	...	...	...	...	...	...	15 4 0	
Sulphate of Iron ...	do. do.	Sickle	...	...	...	...	...	...	...	...	...	...	11 1 6	
Do.	do. do.	ML (in diamond)	...	...	...	...	...	...	...	...	...	...	11 1 6	
Do.	do. do.	CSML	...	...	...	...	...	...	...	...	...	...	1 1 6	
Domestic Garden, No. 2	W. J. Mathews ...	Wonder-growth ...	...	...	...	...	16·5	·35	1·0	17·85	5·0	...	‡	
B.—ORGANIC OR PARTLY ORGANIC.														
1.—ENTIRELY ORGANIC:														
(a) Bonedust and Meals:														
Standard Bonedust ...	Cresco Fert. (W.A.), Ltd.	Cresco	...	...	...	2·75	...	...	18·3	18·3	...	...	10 1 0	
Pure bonedust	do. do.	do.	...	...	...	3·5	...	...	22·0	22·0	...	...	11 10 0	
Bonedust	Cuming Smith, Mt. Lyell	Sickle	...	...	...	3·5	...	...	22·0	22·0	...	...	10 1 6	
Do.	do. do.	ML (in diamond)	...	...	...	3·5	...	...	22·0	22·0	...	...	10 1 6	
Do.	do. do.	CSML	...	...	...	3·5	...	...	22·0	22·0	...	...	10 1 6	
Standard Bonedust ...	Binney & Son	Swan	...	...	...	2·75	...	...	18·3	18·3	...	...	10 0 0	
Bonedust Special, No. 1	do.	do.	...	...	...	3·5	...	...	22·0	22·0	...	...	11 10 0	
Standard Bonedust ...	D. F. Carbarns & Co. ...	Crown	...	...	...	2·75	...	...	18·3	18·3	...	...	10 0 0	
Bonedust Special, No. 1	do. do.	do.	...	...	...	3·5	...	...	22·0	22·0	...	...	11 10 0	
Bonedust	Henry Wills & Co. ...	W (in diamond)	...	...	...	2·75	...	6·0	13·0	19·0	...	...	10 0 0	
Do.	W.A. Meat Exports, Ltd.	Eclipse	...	...	...	3·5	...	...	22·0	22·0	...	...	10 0 0	
Do.	J. Cherry	K.B.M.	...	...	...	3·0	...	...	18·0	18·0	...	...	7 0 0	
Bone Fertiliser	do.	K.B.M.	...	...	...	3·0	...	...	18·0	18·0	...	...	7 0 0	
(b) Bone Fertilisers:														
Blood and Bone ...	W.A. Meat Exports, Ltd.	Eclipse	...	...	6·0	...	...	...	12·0	12·0	...	...	10 0 0	
Do.	Cresco Fert. (W.A.), Ltd.	Cresco	...	...	6·0	...	...	...	12·0	12·0	...	...	10 5 0	
Do.	Cuming Smith, Mt. Lyell	Sickle	...	...	6·0	...	...	...	12·0	12·0	...	...	10 0 0	
Do.	do. do.	ML (in diamond)	...	...	6·0	...	...	...	12·0	12·0	...	...	10 0 0	
Do.	do. do.	CSML	...	...	6·0	...	...	...	12·0	12·0	...	...	10 0 0	
Do.	Midland Junction Abattoirs	State Abattoirs ...	...	...	6·0	...	...	...	9·0	9·0	...	...	10 0 0	
Do.	A. H. Hassell	Sun	...	...	5·25	...	...	8·5	4·5	13·0	...	...	11 0 0	
Do.	Haynes & Clements ...	A1	...	...	5·25	...	...	3·0	9·0	12·0	...	...	11 0 0	
Do.	Wyndham Meat Works	Wyndham Meat Works	...	...	5·75	...	...	6·0	7·0	13·0	...	...	9 10 0	
Do. A	Binney & Son	Swan	...	...	7·0	...	...	...	15·0	15·0	...	...	14 0 0	
Do. B	do.	do.	...	...	6·0	...	...	...	12·0	12·0	...	...	10 10 0	
Do.	G. W. Pennell	A.N.A. Surprise	...	...	5·5	...	...	4·0	10·0	14·0	...	...	10 10 0	
Do.	J. Kitchen & Son ...	Apollo	...	...	5·25	...	...	3·0	12·0	15·0	...	...	9 5 0	
Do.	Dickson, Primer & Co.	Apex	...	...	7·0	...	...	...	10·0	10·0	...	...	10 5 0	
Do. B	do. do.	do.	...	...	6·0	...	...	...	16·0	16·0	...	...	10 0 0	
Do.	John Tyler	JT (over No. 10)	...	...	5·25	...	...	...	12·0	12·0	...	...	10 10 0	
Do.	A. Richards	Vigor	...	...	5·0	...	...	...	14·0	14·0	...	...	10 0 0	
Do.	D. F. Carbarns ...	Crown	...	...	5·6	...	...	...	14·0	14·0	...	...	10 10 0	
Globe Bone Manure ...	Binney & Son	Swan	...	...	2·0	...	...	...	18·0	18·0	...	...	8 15 0	
Fish Fertiliser	do.	do.	...	...	4·5	...	...	...	12·0	12·0	...	...	12 0 0	
Garden Fertiliser, D ...	do.	do.	...	...	1·85	...	...	...	8·3	8·3	...	...	8 0 0	

FERTILISERS *continued.*

Name of Fertiliser.	Firm.	Brand.	Fertilising Ingredients.										Price per ton on rails at works or Perth.
			Nitrogen (N) as				Phosphoric Acid (P_2O_5) as				Potash (K_2O).		
			Nitrate.	Ammonia.	Blood and Bone.	Bone.	Water sol.	Citrate sol.	Acid sol.	Total.	Sulphate.	Muriate.	
			%	%	%	%	%	%	%	%	%	%	£ s. d.
2.—Partly Organic:													
(a) Nitrogen and Phosphoric Acid:													
Bone and Super ...	Cresco Fert. (W.A.), Ltd.	Cresco	...	...	...	2·0	9·5	3·9	3·0	16·4	...	...	7 17 6
Do.	Cuming Smith, Mt. Lyell	Sickle	...	...	...	2·0	13·0	·8	4·7	18·5	...	...	7 4 0
Do.	do. do.	ML (in diamond)	...	...	...	2·0	13·0	·8	4·7	18·5	...	...	7 4 0
Do.	do. do.	CSML	...	...	...	2·0	13·0	·8	4·7	18·5	...	...	7 4 0
Do. No. 1	Binney & Son	Swan	...	...	...	1·37	...	...	17·65	17·65	...	...	6 10 0
Do. No. 2	do.	do.	...	...	...	·75	...	...	11·89	11·89	...	...	4 10 0
Orchard Fertiliser ...	Paterson & Co., Ltd. ...	Patco	...	...	5·0	...	...	...	12·0	12·0	...	...	10 10 0
Domestic Garden, No. 1	W. J. Mathews ...	Wonder-growth ...	...	...	3·75	...	12·0	·3	3·2	15·5	...	...	‡
(b) Nitrogen, Phosphoric Acid and Potash:													
Bone Super Potassium	Binney & Son	Swan	...	...	...	1·0	...	...	14·0	14·0	...	1·0	5 10 0
Special Potato (Bone basis)	do.	do.	...	...	...	3·0	...	...	15·0	15·0	...	2·25	9 10 0
Orchard Fertiliser, No. 2	do.	do.	...	...	...	**3·17	...	...	10·0	10·0	...	5·0	12 0 0
Orchard Manure ...	J. Cherry	K.B.M.	...	...	...	3·0	...	...	16·0	16·0	4·0¶	...	7 0 0
Potato Manure	do.	K.B.M.	...	...	...	3·0	...	...	16·0	16·0	1·0¶	...	7 0 0
Fertos Manure	L. C. Horley	Fertos	...	4·2	...	...	5·5	1·35	2·30	9·1	...	5·9	‖

* Price not available. † Nitrogen partly in Nitrate form as Sodium Nitrate. ‡ Sold in small packets only. § Manganese as MnO_2 5·75 per cent. ‖ On rails, Albany.
¶ Potash from Wood Ash. ** Nitrogen partly as Ammonia.

THE PEA WEEVIL

(Bruchus pisorum, Linn).

By L. J. Newman, F.E.S., Government Entomologist.

The Pea Weevil is found in many parts of the world, but until quite recently was not recorded in Western Australia. It is regarded as a native of Europe. The spread or distribution of this pest has undoubtedly been per medium of infested seed.

Just how and where it gained entrance to our State may never be determined, but the fact remains that it has become established in several areas in the South-West. Local infested seed has been obtained from several widely separated localities.

These notes have been prepared with the object of assisting growers in recognising the weevil when they see it, and advising what methods of prevention and control to apply.

It is not a true weevil in the entomological sense, but generally it is known as such, hence the common name, Pea Weevil.

The damage caused is, in the main, to field pea crops grown for storage and dry feed purposes. Peas grown for consumption in the green stage are not seriously injured. The tiny grubs may be present, but being so undeveloped they do not affect the food value of the peas.

This so-called weevil does not continue to breed in stored dry peas. The attack never begins in storage and stops with stored seed, with the emergence of the insects that came within the seed from the field. If the peas are free when gathered from the field, they will not be attacked by this weevil. The infestation only takes place in the field, when the peas are green and in the pod. It is essential to the full development of the larva in the pea for the seed to reach maturity.

Infested seed stored away permits of the life cycle of the insect being completed. Infested seed is rendered useless for sowing and for feeding purposes.

DESCRIPTION OF ADULT.

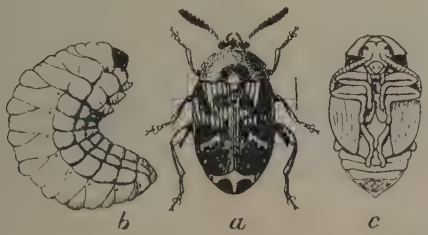


Fig. 1.—Pea Weevil: *a*, beetle; *b*, grub; *c*, pupa. True length of beetle shown by line at its right. (Chittenden U.S.D.A. *Yearbook*, 1898.)

General colour, from fawn brown to dark rusty brown, shading to black, with small patches of white hairs that form white spots upon the elytra or wing covers. There is also a distinct white patch at the basal centre of the thorax. The wing covers are shorter than the abdomen, leaving the pygidium or last dorsal segment exposed.

This segment is furnished with downy white hairs, with the exception of two black areas which, in contrast to the white, constitute conspicuous markings.

The legs and undersides of the body are dark reddish black. The antennae or feelers black, with the last four segments reddish yellow. The body length is between 3 16in. and 1 4in. The mature beetles are capable of flight. The adults make their appearance any time after December. Those that emerge and those that remain in the seed appear to aestivate during the dry summer months.

As the early winter comes in, some of the beetles become active. The bulk of them, however, do not issue forth until the early spring. It is certainly the spring outbreak that we have to fear, as it is this brood that attacks the young forming pea seeds.

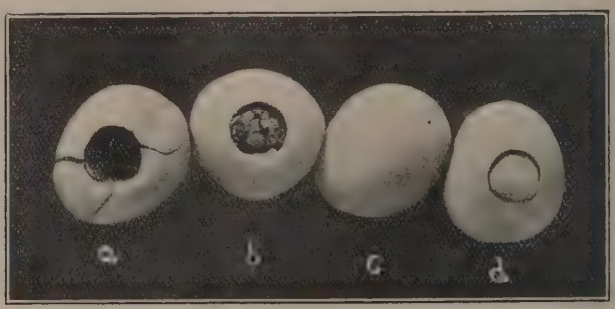
The beetles appear to feed upon any part of the plant, but do not cause serious damage. It is to the stored seed that the great economic loss occurs.

The Eggs.—These are oval, yellow bodies, glued to the exterior of the young pea pods. They are generally deposited singly, for the reason that there is only sufficient nourishment in a pea for one larva or grub. From 25 to 30 eggs are deposited by each female beetle.

The normal spring incubation period for the eggs is about 21 days.

The Larva.—The young grub, upon hatching from the egg, immediately burrows straight down into the pod. It possesses six short inconspicuous legs and powerful gnawing jaws. Having bored through the pod, it selects a young developing pea and cuts its way into it. Once ensconced within the pea, the larva or grub moults, when its legs are reduced to mere stumps. Here the grub spends the whole of its life, which occupies about three months, going through several moults, finally pupating and eventually cutting its way out an adult beetle.

The grub, before pupating, eats away the substance of the pea at one end, leaving only a thin circular semi-transparent cap, which is easily noticeable and is a typical indication of an infested seed.



A.—Showing exit hole of adult weevil. B.—Adult weevil within pea ready to emerge. C. & D.—Infested peas showing typical indication of the weevil within.

Original—Andrewartha.

The Pupa.—This stage is also spent within the pea and lasts under normal weather conditions for three weeks.

PREVENTIVE AND CONTROL MEASURES.

Knowing that this pest is spread per medium of infested seed, keep a keen lookout. Any insects found in seed peas should be forwarded to the Entomological Office for identification. Never sow infested seed. If growing for seed, gather as soon as sufficiently ripe for stripping or thrashing. The longer the crop is left standing, the greater the damage.

When seed has been harvested, and weevil is suspected, treat with some approved fumigant. If this treatment is given as soon as the seed is gathered very little harm will have been done, as the larvae or grubs within the seeds have not reached their greatest damaging stage. If kept for a month the grubs will have greatly increased in size and eaten out large cavities in the peas. If kept for two months, without treatment, the grubs will have matured, resulting in only the outer shell of the pea being left. It is obvious that the seed must be treated as soon as gathered. The fumigant recommended is carbon-bisulphide.

The pea crop should be sown as early as possible, so that the crop can be harvested before the weevil has become seriously active. It is advisable to harvest the crop as much on the green side as is safe, rather than is usually done when the seed is left to get dead ripe. Pea hay or straw so cut contains a higher nutritive value; the seed is heavier and its germinating powers are not affected.

Rotation of crops is an important method of control. Each year the pea crop should be put in as far away from the previous year's crop as possible. This is necessary because many of the infested peas are shed to the ground before the crop is harvested.

A good purpose is served by allowing pigs or poultry to feed over a paddock which has previously carried an infested crop. They will clean up all the fallen peas. Infested land must be later thoroughly ploughed, seeing that the soil is well turned over.

All peas kept in storage should be bagged in sound bags, the tops being securely tied. If infested, the weevils will hatch out and die in the bags without further reproduction.

Hot Water Treatment.—Pea seed may be soaked for five minutes in a mixture of two parts of boiling water to one part of cold water, without being harmed, yet the grubs inside them will be destroyed. If not being sown then, they should be dried as rapidly as possible. The quantity of water used must be considerably in excess of the bulk of seed treated to allow for the take up and the complete covering. This is probably the most economical method the farmer can use for the treatment of small lots of seed.

Fumigation.—The most effective method is the exposure of the seed to the fumes of carbon-bisulphide. For the best results the seed should be treated as soon as possible after gathering.

For the purpose of applying this gas, it is essential to provide an air-tight room or receptacle. These should be tested and proved to be gas tight. The amount of the fumigant to be used is calculated upon the cubic feet of space to be fumigated. In the treatment of the pea weevil, it is essential to give a strong charge to ensure the gas penetrating the fine borings made by the grubs when entering the young developing peas.

Formula.—To every 1,000 cubic feet of space use 3 lbs. of carbon-bisulphide. The fumigant may be poured directly on to the seed or on to pieces of bagging or into shallow dishes. Being a heavier than air gas, it is always applied to the top of the produce being treated. The gas falls downwards and has a most penetrating power. The period of fumigation should not be less than 48 hours, and should not exceed 60 hours.

To find the cubic contents of a room or other receptacle having rectangular sides, multiply the length x breadth x height. Example:—A room 10ft. x 10ft. x 10ft. = 1,000 cubic feet of space.

A good sound barrel makes a good medium for the fumigation of small lots of seed. Take an ordinary 25 gallon barrel. This will accommodate a 200lb. bag

of seed. It should be made as airtight as possible by the application of two or three coats of paint and the stuffing up of any joints at the bottom. To a barrel of this size, use one fluid ounce (two tablespoonfuls). If any leakage is suspected, double the dose. The barrel should be covered with wet bags, weighted down.

If any other type of small container is used, calculate the amount of fumigant to be applied by the weight of seed to be fumigated.

Formula.—To every 200 lbs. of seed, use 1 fluid ounce of carbon-bisulphide.

Warning.—In using the carbon-bisulphide, all naked lights must be kept away, as it is explosive and inflammable. Do not enter any room so fumigated until it has been thoroughly ventilated and all traces of the gas have disappeared. With ordinary care and intelligent application, this fumigant is perfectly safe to use.

As this weevil has the potential possibilities of becoming a serious pest to field peas grown for storage and seed, every effort should be made to restrict its breeding.

Literature cited.—Pea and Bean Weevils.
S. H. Skaife, B.A., Assistant Entomologist,
Department of Agriculture, Pretoria, 1918.

SOLENOPOTES CAPILLATUS, ENDERLEIN, A SUCKING LOUSE OF CATTLE HITHERTO UNRECORDED FROM AUSTRALIA.

B. A. O'CONNOR, B.A., B.Sc.Ag., Agricultural Adviser.

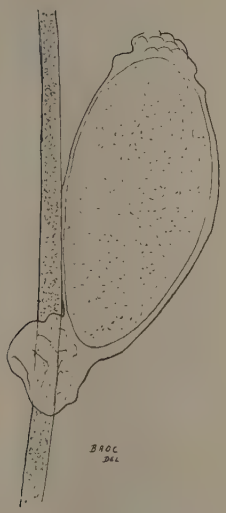
J.M.R.

On 16th March of the present year Mr. J. F. Filmer, B.V.Sc., Senior Veterinary Surgeon attached to the Departmental staff, brought in for identification some lice which he considered appeared unfamiliar. They had been found clustering on the neck and head of a heifer at Herne Hill, about 15 miles from Perth. On examination, the lice proved to be neither of the common sucking lice of cattle, *Linognathus vituli*, L. and *Haematopinus eurysternus*, Nitsch., but appeared to belong to the genus *Solenopotes*. Reference to Bishopp's paper on *Solenopotes capillatus*, End., established that the local specimens were of that species.

Slight variations from Bishopp's description occur in the chaetotaxy, but these do not appear to be of specific importance. The two small spines occurring on the dorsal surface of the head near the median line opposite the point of attachment of the antennae, were not found in the local specimens. The number of spines on the fifth abdominal tergite is given by Bishopp as 6 to 8, whereas in our specimens there are as many as 10. Also, on either side of the dorsum of the mesothorax, slightly inside and posterior to each mesothoracic spiracle, is a long spine, hair-like at the end, similar to those occurring on the terminal portion of the abdomen. Such a spine is not mentioned by Bishopp.

The occurrence of the lice on the neck and head of their host agrees with Bishopp's statement that "the species shows a marked tendency towards attacking in dense groups about the head and neck of the host."

As far as the writer is aware, this species has not formerly been recorded from Australia, and no satisfactory explanation can be advanced to account for its



Egg of *Solenopotes capillatus* attached to hair of host. × 60.

Solenopotes capillatus: Ventral view of male. × 70.

Solenopotes capillatus: Ventral view of female. × 45.

Solenopotes capillatus: Dorsal view of female. × 45.

presence in this State. Enderlein described it from a male taken on cattle at Leipsig, Germany, in 1904. It was not known to occur in U.S.A. till 1917, when H. P. Wood identified specimens as belonging to this species. The earliest record from U.S.A. given in Bishopp's paper is 20th March, 1910.

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SILAGE COMPETITIONS, 1932.

WITH SOME NOTES ON MAKING SILAGE.

G. K. BARON-HAY, Superintendent of Dairying.

During the past season the interest shown by farmers in the production of silage has been most marked and has led to a considerable increase in the number of silos and stacks throughout the whole of the dairying districts. One of the ways in which this interest has been brought home to farmers is by the number of competitions held by various organisations in connection with the judging of the best exhibit of silage both at shows and in the field. These competitions have brought out very forcibly a number of factors which are essential for the production of good silage in an economical manner. The results of these competitions are given below, together with a few notes which will be of interest to those intending to make silage during the coming season.

HARVEY AGRICULTURAL SOCIETY—SILAGE COMPETITION.

The Field Committee of the Harvey Agricultural Society, which is a committee whose duty is to encourage and inquire into various methods of agriculture which would be of benefit to the district, recommended the carrying out of a Silage Competition for the first time last season. Only three entries were received, although a number of other stacks were built in the district, the owners of which did not consider them suitable for competition.

Judging was carried out late in February by Mr. C. Giles, Dairy Adviser, with the following results:—

Name.	Material and Mixture.	Type, Palatability and Value.	Percentage Waste.	Time of Cutting.	Workmanship, Finish, etc.	Total Points.
S. Fry, Benger ...	18	26	23	9	8	84
J. Smith, Wokalup ...	18	23	21	8	8	78
S. Bowers, Brunswick Junction	20	16	18	8	8	70

Mr. S. Fry, Benger.—A very good sample of grass silage; approximate tonnage of stack 45-50, of a light brown acid type; readily eaten by stock.

Mr. J. Smith, Wokalup.—Stack approximately 20 tons; acid type; brown in colour, showing less succulence than above; cut at later stage.

Mr. S. Bowers, Brunswick.—Approximate tonnage 20-25; dark sweet silage, excellent mixture (clover predominating), but ensiled at too high a temperature due to late cutting and slow handling.

The Judge, Mr. C. Giles, in his remarks stated that the waste in the stacks examined was excessively high, ranging from 20 to 30 per cent., which, however, could be avoided by earlier cutting and carting more rapidly from the field to the stack. The stack also should be opened from the top, the silage being removed in layers rather than from the side.

Several stacks in the district slipped over on the eastern side during the season. This was caused by the long bouts of hot easterly winds experienced, causing excessive drying and thus admittance of air into the windward side of the stack. It is suggested that where the stack is built in an exposed position, the windward side should be protected by bushes or bags.

BALINGUP AGRICULTURAL SOCIETY—SILAGE COMPETITION.

In order to encourage the building of a larger number of stacks for the conservation of fodder in this district, the above Society promoted a competition for the best silage stack.

Stacks were judged during the last week in March. Results of points allotted are as given in the following table:—

Name.	Material and Mixture.	Type, Palatability and Value.	Percentage Waste.	Time of Cutting.	Workmanship, Finish, etc.	Total Points.
M. Dunstan	20	27	22	9	6	84
F. Holbrook	18	30	15	10	7	80
H. M. Moulden ...	15	27	16	9	9	76
G. E. White	20	27	15	7	5	74
W. Jenkins	15	23	12	7	6	63
W. Bailey	11	15	6	10	8	50

The following notes on the stacks examined were made by the Judge, Mr. M. Cullity, Agricultural Adviser:—

Mr. M. Dunstan.—Very good sample of subterranean clover and grass silage; slightly acid; of a good green colour, the clover being only slightly changed. Wastage was due to the uneven settling and to opening the stack by cutting into the side.

Mr. F. Holbrook.—A good stack of clover and grass silage with an excellent appearance.

Mr. H. M. Moulden.—Practically a pure grass silage, slightly acid, with a yellowish-brown colour. The wastage was greater in this stack than in the grass and clover mixture.

Mr. G. E. White.—A stack of oat, grass, and clover silage which varied from sweet to acid and of a brown to green colour. Much waste occurred from opening the stack from the sides.

Mr. W. Jenkins.—Stack composed almost completely of grass, slightly acid, dark brown to yellow. Wastage due to the sides not being sufficiently tramped, and the material used being cut rather too mature.

Mr. W. Bailey.—Stack composed of oats with peas on top; the edges resembled hay and the centre had over-heated. Wastage was due to the oats being cut too mature, but it was all readily eaten by stock. The pea silage was fed to the pigs with success.

Semi-hillside stack of silage. P. J. Trigwell, Donnybrook.

DONNYBROOK DAIRY FARMERS' ASSOCIATION—SILAGE COMPETITION.

This competition, designed to encourage the use of silage, was the first organised by the above Association which is performing much useful work of special value to dairy farmers in the district.

Judging was carried out on 6th February with the following results:—

Name.	Material and Mixture.	Type, Palatability and Value.	Percentage Waste.	Time of Cutting.	Workmanship, Finish, etc.	Total Points.
R. J. Trigwell ...	20	30	27	10	8	95
H. T. Williams ...	17	25	25	9	7	83
A. Trigwell	15	23	25	8	8	79
C. J. Cunningham ...	17	23	23	8	7	78
W. J. Sears	16	21	18	6	7	68
J. G. Fry	12	18	18	5	6	59

The following notes regarding the exhibits were made by the Judge, Mr. G. K. Baron-Hay, Superintendent of Dairying:—

Mr. R. J. Trigwell.—A stack of 40 tons silage of the acid-fruity type, of excellent quality; cut second week in October, 8 days being required to complete the stack; waste 3 to 4 inches. Material almost wholly Subterranean clover, being light green in colour. (See illustration 1.)

Mr. H. T. Williams.—Stack approximately 54 tons, cut from 10 acres; sledge used in carting, which occupied 10 days; weighted with 3 tons of sleepers; cut second and third week in November, rain falling whilst stack being built. Material Lotus major, Subterranean clover and oats; acid type much relished by stock.

Mr. A. Trigwell.—35-ton stack, requiring 10 days to build; material carted with sweep costing 35s. to make; cut from 8 acres; sweet type, brown in colour; material cut too mature.

Mr. C. J. Cunningham.—30-ton stack; low clover content in material; sweet brown type of silage; material cut too mature.

Mr. W. J. Sears.—Stack approximately 40 tons; cut during second week in October; material too dry.

Mr. J. G. Fry.—Stack approximately 32 tons. Material largely grass, cut too dry during the middle of October. This stack was sunk 4 feet in the ground, thus saving some wastage and labour in building; considered a good plan if drainage good.

Farmers inspecting silage at Mr. H. T. Williams' Farm, Donnybrook. Note method of opening stack from top.

NORTHAM AGRICULTURAL SOCIETY—SILAGE COMPETITION.

The competition, organised by the Northam Agricultural Society, has been conducted for a number of years and has been instrumental in not only demonstrating the great value of silage to the district but in raising the standard of the quality of silage made by all competitors. Judging took place on March 30.

A special scale of points was necessary for judging in this district, as all silage exhibited was made in overhead concrete tub silos.

The competition was judged according to the following scale of points:—

1.	Material and mixture ensiled	20 points.
2.	Type, palatability, and value	30 „
3.	Percentage waste	30 „
4.	Time of cutting	10 „
5.	Method of feeding	10 „
	Total	100 „

The results were as follow:—

Name.	Material and Mixture.	Type, Palatability & Value.	Percentage Waste.	Time of Cutting.	Method of Feeding.	Total Points.
H. D. Morgan, "Irishtown" ...	20	23	24	8	10	85
W. G. Spencer, "Grass Valley" ...	10	25	28	7	8	78
D. Munro, "Lynden"	10	26	27	9	5	77
E. McManus, "Minathorpe" ...	10	23	27	7	5	72
M.Drake-Brockman,"Beechborough"	10	21	20	7	5	63

Feeding silage to ewes with lambs. H. D. Morgan, Northam.

The following notes regarding the exhibits were made by the Judge, Mr. G. K. Baron-Hay:—

Mr. H. D. Morgan.—Mr. Morgan filled his two 80-ton silos from 24 acres of oats and peas. This mixture has been demonstrated to give far better returns when fed than where a cereal crop only is ensiled. Mr. Morgan experienced trouble with his sheep prior to silage being fed, owing to their depraved appetite for rabbits, dung, and carcases. 950 sheep, together with 13 head of cattle, were being fed 2 to 3 lbs. silage per day. The silage was of excellent quality, being of the sweet fruity type.

Mr. W. G. Spencer.—30 acres of oats filled two 80-ton silos. All stock on the farm are being fed silage, *i.e.* sheep, cows, pigs, and horses. 900 sheep are being fed 2½ lbs per day, the silage being sufficient to feed from the beginning of February until the end of June. Sows received very little else. The silage was of excellent quality, being of the sweet fruity type.

This crop was ensiled after the Royal Show. Best results in this district are obtained by cutting early prior to the Royal Show.

Mr. D. Munro.—30 acres of "Mulga" oats produced 185 tons silage. In previous years Mr. Munro cut his crop when too mature, but this season the crop was ensiled at the end of September and early in October, the silage being of excellent quality.

Mr. Munro conducts a dairy and feeds 42 cows and 13 yearlings throughout the summer, the cows averaging just under two gallons milk per day, which is an extremely good average. This would be quite impossible without silage.

Mr. E. McManus.—45 acres of oats produced 155 tons silage, which is used for feeding to 30 head of dairy cattle. An excellent sample of silage was seen, being acid-fruity in type.

Mr. McManus estimated the cost of producing silage at from 7s. 9d. to 12s. per acre, the cost varying as to whether the area required to produce the silage is 25 acres or 40 acres.

A trench silo in 1930, converted in 1931 by Mr. M. Drake-Brockman.

Mr. M. Drake-Brockman.—The silo here was originally a trench silo, the ends of which had been blocked by a stone wall and raised approximately 6 feet above the ground. The silo was 13 feet high by 25 feet long by 10 feet wide; capacity approximately 55 tons. The cost of building the walls for this silo was £20.

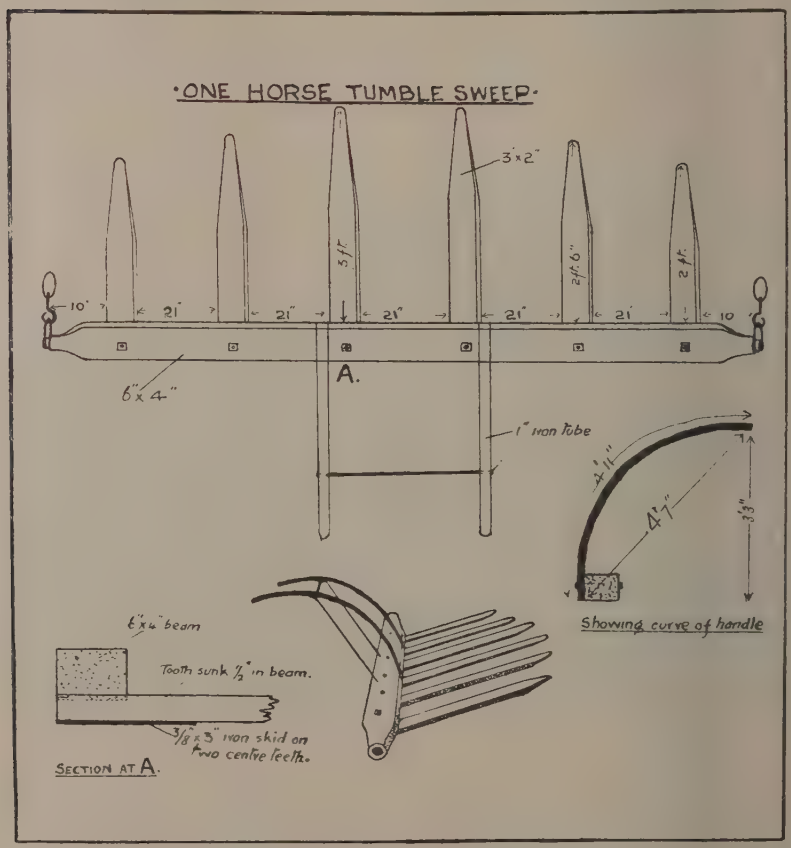
Mr. Brockman first tried silage in 1930-31 in a trench, but, owing to the difficulty of excavating the silage, decided to convert the trench into a cheap tub silo.

The results show that good silage can be made in a variety of ways, and that, although the overhead concrete silo is an advantage, the capital cost involved in same may be saved by the use of a type such as that tried by Mr. Brockman. 150 sheep were being fed on the day of inspection, but 500 were to be fed in addition at an early date.

NOTES ON PRODUCTION OF SILAGE.

The results of these competitions have brought out a number of points which it is necessary to observe in order to make silage efficiently. As most of these, however, have been dealt with already in previous numbers of the Journal, which are now obtainable as reprints,* available on application at the Department of Agriculture, only a brief mention is necessary.

1. Any green crop may be ensiled. Cereals, however, are unsuitable for building into stack silage, owing to high percentage of waste.



Plan of details of One-horse Tumble Sweep.

* *Journal of Agriculture*, September, 1930, "Cheap Face-cut Silos." *Journal of Agriculture*, March, 1930, "Stack Silage." Bulletin 211: "Silage, Ensilage and Silos."

2. Best results are obtained with stack silage where herbage contains a large percentage of leguminous plants.

3. Grass should be cut for silage before seed heads form, as the percentage of fibre increases very rapidly with maturity, leading to waste during fermentation owing to access of air.

4. Clovers should be cut while forming seed and before wilting commences.

5. A cereal and pea silage will give better results when fed to stock than silage from a cereal crop only. Owing to the difficulty of growing these two crops together, a system of sowing in alternate strips is recommended. The strips are cut across with the binder and are mixed automatically during cutting and blowing into silo.

6. *Handling the Material.*—Almost the only expense incurred in the making of stack silage is that of handling the crop, which, without labour-saving devices, may be unnecessarily high.

   The heavy work of loading green material on to drays or wagons may be considerably lightened by the use of the "Tumble Sweep."

   One-horse Tumble Sweep.—Reference to the accompanying illustrations will show the principle of the sweep, which may be used for handling green or dry material. Full details regarding construction also are given in the attached plan.

7. The stack should be round or square; never oblong, and preferably round. Stacks of less than 20 tons are not recommended.

   The following table shows the dimensions of the base for stacks of varying capacities:—

	Round. Diameter—feet.
20 tons	12
30 tons	14
40 tons	16
50 tons	18

8. *Yield of Grass Silage per acre.*

   A good crop of subterranean clover fifteen to eighteen inches high will yield approximately 7 tons of green material per acre, equal to a 2-ton hay crop.

9. The base of the stack should be level and built on a well-drained site.

10. Care should be taken not to always unload at the same side of the stack, otherwise this section will be unduly tramped, causing uneven settling. Build the stack as evenly as possible, keeping the surface level.

11. Cutting and carting should proceed simultaneously or as near to each other as possible. Wet weather will not affect silage making.

12. Building should proceed as rapidly as possible, as this keeps the temperature down, resulting in less fermentation losses and good quality silage.

13. During the last summer a number of stacks toppled over, caused by overheating on the exposed or windward side, leading to more rapid sinking. Some protection is advisable until settling is completed, such as a screen of bags or a tarpaulin, or even brushwood, to break the force of the drying wind.

One-horse Tumble Sweep being operated on farm of Messrs. Bayley Bros., Denmark.

14. When completed the stack should be weighted to ensure even settling. A row of sleepers around the edges, the centre being filled with earth to a depth of 12 inches makes a good seal.

A layer of bags of earth is preferred by some farmers and is quite effective.

Showing tumbling action of sweep, minimising handling the material.

15. Stacks should be opened from the top, a full layer not less than 1½ inches thick being removed each day. Opening from the sides exposes a fresh surface unduly, causing waste.

16. Good clover silage does not need the addition of a concentrate when fed to cows of average production. When silage is made from grass or cereal crops, however, disappointing results are obtained where fed alone to milch cows, ewes, or lambs. The addition of a concentrate, such as oats, bran, linseed meal, peas, etc., is then necessary to increase the protein content, otherwise supplied by the leguminous crop.

FIELD EXPERIMENTS WITH MANGANESE ON WHEAT AND OATS, 1931.

MURESK AGRICULTURAL COLLEGE,

H. J. Hughes, Principal, and J. H. Riches, Experimentalist.

Except for a period of exceptionally cold weather in June, which retarded growth somewhat but may have induced greater stooling, the season was favourable for crops.

The monthly rainfall, as recorded at the College, together with the averages since its inception in 1926, and the averages for Northam, nine miles distant, are given in the following table:—

Table 1.—Rainfall.

Period.	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1931	0	20	23	85	383	167	397	374	275	60	1,656	2	28	1,814
Average 6 years, 1926-1931 ...	19	23	113	67	211	329	484	257	162	92	1,535	34	30	1,821
Av'age Northam, 45 years ...	29	41	67	80	222	330	332	258	167	99	1,408	38	35	1,698

The soil on which the experiments were planted was fairly heavy, part of it overlying an epidiorite dyke. It was fallowed during 1930, springtyne cultivated in November and prior to seeding. The experiments were planted on 6th June.

The results obtained are set out in the accompanying table:—

Manganese Experiments.

Wheat Section.

Variety—Nabawa. Rate of Seed—60lbs. Rate of superphosphate—112lbs.

Manganese Sulphate per Acre.	Computed Yields per Acre.												Percentage Yield.
	Section 1.		Section 2.		Section 3.		Section 4.		Section 5.		Average.		
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%
28 lbs. ...	17	26	19	23	24	33	27	27	25	12	22	48	104
Nil ...	14	32	19	23	24	52	26	29	24	32	21	58	100
56 lbs. ...	17	46	22	37	26	29	25	50	21	19	22	48	104

Oats Section.

Variety—Mulga. Rate of Seed—60 lbs. Rate of Superphosphate—112 lbs.

Manganese Sulphate per Acre.	Computed Yields per Acre.												Percentage Yields.
	Section 1.		Section 2.		Section 3.		Section 4.		Section 5.		Average.		
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%
28 lbs. ...	47	20	*		52	32	58	5	53	12	52	37	100
Nil ...	52	1	54	30	53	8	55	29	47	0	52	33	100
56 lbs. ...	53	12	53	12	54	11	51	14	28	23	46	35	89

* Part of the yield of this plot was accidentally lost ; Section 2 was, therefore, excluded in computing the averages.

It would be unsafe to generalise on one year's results, but it appears unlikely that the application of manganese to wheat and oats crops would prove profitable on soil similar to that tested.

FARMERS' FIELD TRIALS, 1931.

A. S. WILD, Agricultural Adviser.

BENN BROS., BOSCABEL.

Wheat Variety Trial.

During 1931 a wheat variety trial was conducted on the property of Messrs Benn Bros. at Boscabel, situated about thirteen miles North of Kojonup.

The soil on which the experiment was planted varied from a sandy loam to a gravelly loam and originally carried white gum, jam and sheoak timber.

The ground was prepared by ploughing 3½in. deep early in September with a mouldboard plough. It was then left until April, when it was springtyne cultivated.

The following are the monthly rainfalls as recorded at Boscabel during the year, together with the average rainfall:—

	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May	June.	July.	Aug.	Sep.	Oct.	Total.			
1931 ...	1	15	137	149	220	231	303	412	398	86	1,650	27	76	2,055
Average 16 years ...	46	55	118	137	305	377	370	289	244	167	1,752	66	41	2,215

All plots germinated well and growing conditions early in the season were fairly good. The Bencubbin and the control variety, Steinwedel, made particularly forward growth and appeared better than the Nabawa. By the middle of September, however, the ground had become excessively wet, and this checked the growth of all varieties. Both the late varieties, Yandilla King and Sutton, appeared to suffer particularly from these wet conditions.

The following table shows the results obtained from the experimental plots, each of which was .4 acre in area:—

Planted 1st May. Rate of Seed—60lb. per acre. Rate of Superphosphate—112lb. per acre.

Variety.	Computed Yield per acre.						Percentage Yield per acre.
	Section 1.		Section 2.		Average.		
	bus.	lb.	bus.	lb.	bus.	lb.	%
Nabawa ...	9	12	5	7	7	10	54
Steinwedel (Control)	15	25	11	2	13	14	100
Beneubbin ...	15	0	17	0	16	0	124
Yandilla King	7	20	8	22	7	56	55
Steinwedel (Control) ...	8	17	14	30	11	24	86
Sutton	2	17	5	30	4	4	30

These results indicate that, under the conditions of growth at Boscabel during 1931, the most prolific variety is Beneubbin.

S. W. SANDELLS, LAKE BIDDY.

In addition to the Manganese Fertiliser Trial described in another article, a wheat variety trial was conducted on the property of Mr. S. W. Sandells, Lake Biddy.

The site of the experiment was adjacent to the Lake Biddy townsite. The land consisted of a loamy soil which originally carried blackbutt, morrel and silver salmon timber. It had been ploughed with a mouldboard plough during July, 1930, springtyne cultivated in October, again in March, and finally immediately proir to seeding.

The following table shows the rainfall as recorded at Lake Biddy during the year:—

	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for Year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1931	25	25	51	100	127	168	287	199	58	1,033	18	20	1,172
6 years average...	15	15	154	77	157	208	231	170	142	72	980	61	82	1,354

The scantiness of the autumn rains was not conducive to working the fallowed land preparatory to seeding. Only 101 points were recorded up to the end of April. The June and July rains were also below the average.

Heavy and excessive frosts and general cold conditions during the early portion of the growing period prevented vigorous growth. Late frosts early in October also probably caused some damage to the maturing crops.

The following are the results obtained from the Variety Trial:—

WHEAT VARIETY TRIAL.

S. W. SANDELLS—LAKE BIDDY.

Planted on 28th May, 1931. Seed—45lb. per acre. Superphosphate—112lbs. per acre.

Variety.	Maturity.	Computed Yields per acre.				Average Yields per acre, 1931.		Percentage Yields, 1931.
		Section 1.		Section 2.				
		bus.	lb.	bus.	lb.	bus.	lb.	%
Nabawa	Midseason	6	36	7	44	7	10	84
Gluyas Early	Early	8	30	8	40	8	35	100
Bencubbin	Midseason	9	36	9	50	9	43	113
Carrabin	Early	8	24	9	44	9	4	102
Gluyas Early	Early	8	0	9	46	8	53	100
Merredin	Early	6	4	9	12	7	38	86
S.H.J.	Early	5	48	7	38	6	43	84
Gluyas Early	Early	5	48	10	12	8	0	100
Noongaar	Very early	5	0	7	8	6	4	76

These results demonstrate the suitability of the midseason variety, Bencubbin. The early maturing varieties, Gluyas Early and Carrabin, have also shown to advantage.

The results indicate that the varieties Bencubbin and Gluyas Early may be recommended with confidence for planting in the Lake Biddy district.

BETTER DAIRYING COMPETITION.

G. K. BARON-HAY, Superintendent of Dairying.

During the last year the West Australian Committee of the Australian Dairy Council, with the co-operation of the Department of Agriculture, conducted a Dairy Farm Competition with the object of encouraging increased butter production and improved methods of dairy farming.

The competition was of a most comprehensive nature, taking into account every phase of dairy farm activity.

The country embracing the Clover or Dairy Belt (*i.e.*, land having a rainfall of 20 inches or more) was divided into seven zones, with a special zone for farms on irrigation areas.

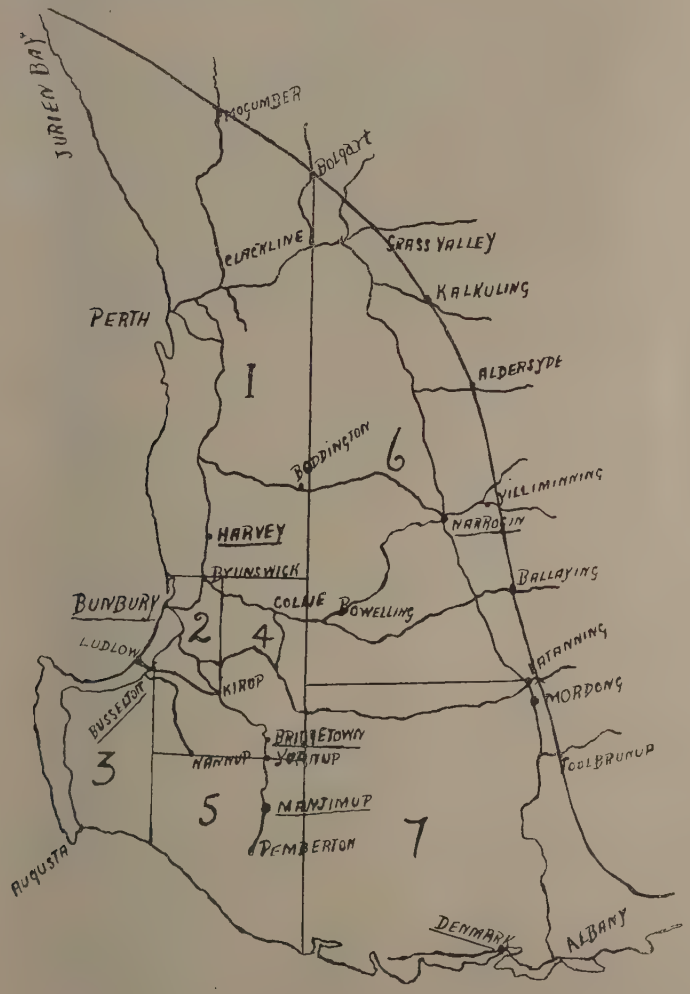
The Central Agricultural Society in each zone co-operated with the Department in distributing literature and in receiving entries. The respective Societies were:—

Zone 1.—Agricultural Society, Harvey.

Zone 2.—Wellington Agricultural Society, Bunbury.

Zone 3.—Agricultural Society, Busselton.
Zone 4.—Agricultural Society, Bridgetown.
Zone 5.—Agricultural Society, Manjimup.
Zone 6.—Agricultural Society, Narrogin.
Zone 7.—Agricultural Society, Denmark.

The zones are shown in Illustration 1.



In allotting the boundaries of these zones, an endeavour was made to group farms under as identical conditions as possible.

The headings under which competitors were judged and the points allotted were as follow:—

		Maximum Points.
1.	Farm Management	75
2.	Dairy Herd	100
3.	Pasture and Fodder Crops	100
4.	Fodder Conservation	150
5.	Utilisation of Separated Milk for Pigs, Poultry, etc.	25
6.	Butter Fat Production: 1st January to 31st December .. .. lb. / Acres devoted to Dairy Farming	50
	Total	500

It will be seen that great importance was attached to fodders and their conservation, as 250 points out of a total of 500 were allotted to these sections.

Owing to the large area covered by the competition, rainfall ranging from 20 to 70 inches, it was found necessary to judge the farms in zones during different times of the year, as follows:—

Zone 1. Judged 1st December, 1931.

Zone 2. Judged 1st December, 1931.

Zone 3. Judged 15th December 1931.

Zone 4. Judged 1st December, 1931.

Zone 5. Judged 15th December, 1931.

Zone 6. No entries.

Zone 7. Judged 1st January, 1932.

Irrigated Farms. Judged 1st February, 1932.

Prizes were offered in each zone as follows:—

First Prize—£8 8s. 0d.

Second Prize—£5 5s. 0d.

Third Prize—£2 2s. 0d.

Through the generosity of Cuming Smith & Mt. Lyell Farmers' Fertilisers, Ltd., a Champion Prize of £10 10s. 0d. was offered, the First Prize winners in each zone being eligible to compete.

The following Tables (1-7) set out the points received by each competitor in the various zones:—

TABLE 1.—POINTS GAINED BY COMPETITORS.

ZONE 1.—HARVEY AGRICULTURAL SOCIETY.

	Max. Points.	S. F. Russell.	L. Pearson.	L. Temple.	H. Masters.	R. Bee.	T. Briggs.	Mrs. C. Settor.
1. Farm Management ... ... (75 points)								
(a) Lay-out and Convenience	30	28	20	22	20	22	15	15
(b) General Management, including, Sanitation, etc.	25	23	18	20	16	18	12	14
(c) Book-keeping and Records	20	20	20	17	18	15	15	15
2. Dairy Herd ... ... (100 points)								
(a) Breeding—System of	25	20	20	25	20	25	25	20
(b) Dairy Type and Condition	30	22	22	27	18	27	25	20
(c) Bull (give particulars of breeding and production ancestry)	25	25	25	25	20	25	25	25
(d) Pigs—breed, condition, etc.	20	13*	16	20	10*	17*	16	15*
3. Pasture and Fodder Crops ... (100 points)								
(a) Pasture	60	53	30	30	39	29	35	28
(b) Fodder Crops:—								
Freedom from Disease	3	3	3	3	...	3	3	3
Freedom from Weeds	7	7	7	6	...	7	6	5
Cultivation and Manuring	10	10	10	9	...	7	9	7
Evenness of Growth	7	5	6	6	...	4	4	4
Yield	13	9	9	7	...	8	8	6
4. Fodder Conservation ... ... (150 points)								
(a) Silage—								
1. Succulency	20	16	16	...	18	...	...	...
2. Mixture	20	16	15	...	20	...	...	...
3. Type of Silage	10	7	7	...	8	...	...	...
4. Percentage Waste	20	13	12	...	14	...	...	...
(b) Hay—								
1. Mixture	20	18	18	12	16	18	16	16
2. Condition	20	18	20	17	16	18	15	16
(c) Amount of Fodder conserved per head ...	20	5	14	7	13	5	12	7
(d) General Lay-out for convenience in feeding	20	18	10	16	12	10	10	10
5. Utilisation of Separated Milk for Pigs, Poultry, etc.... ... ... (25 points)								
(a) Pigs	20	...	20	20	...	...	20	...
(b) Poultry	5	3	5	3	3	...	5	3
6. Butter Fat Production*... ... (50 points)	50	48	23	44	35	42	23	27
Acres devoted to Dairy Farming	...	121	300	89	120	92	300	100
	...	400	391	336	316	300	299	256

* Whole Milk producer; heifer calves reared in good condition, in place of Pigs.

J. P. Norton, Capel. Cows grazing on water couch pasture, providing excellent succulent fodder during the summer.

TABLE 2.—POINTS GAINED BY COMPETITORS.

ZONE 2.—BUNBURY AGRICULTURAL SOCIETY.

	P. Rose.	B. Langridge.	J. P. Norton.	A. Frost.
Lay-out and Convenience	29	20	17	20
General Management and Sanitation	25	20	19	19
Book-keeping and Records... ...	14	20	16	14
System of Breeding	25	22	19	21
Dairy type and condition	30	26	23	26
Bull	25	20	18	19
Pigs	20	18	12	10
Pasture	40	46	58	51
Fodder Crops	4	10	5	7
Silage—				
Succulency	18	15	18	...
Mixture	17	18	17	...
Type	9	5	8	...
Waste	10	8	11	...
Hay—				
Mixture	20	20	15	20
Condition	18	16	17	15
Amount per head	17	13	15	5
Lay-out of feeding	20	17	14	17
Utilisation of skim	20	22	18	20
Butter Fat production per acre ...	24	38	31	50
Total	385	374	351	314

TABLE 3.—POINTS GAINED BY COMPETITORS.

ZONE NO. 3. AGRICULTURAL SOCIETY, BUSSELTON.

	Maximum Points.	A. Oldfield.	E. C. Melville.	A. Miller.	S. Smith.	C. Ironmonger, Wonnerup.	M. Torrent.	H. Johnson.	Nilsson-Lynne.	T. Albutt.	P. O. Farrell.	A. Albutt.	A. W. Langley.	A. H. Wilkinson.	R. W. Webb.	Reading Bros.	W. J. Cox.	W. J. Bryant.	G. H. Doyle.	T. Hugall.
Management ... ... (75 points)																				
Lay-out and convenience	30	28	20	16	26	20	16	20	22	22	24	26	20	20	20	18	20	20	22	20
General Management and Sanitation	25	23	18	15	22	15	12	15	15	17	20	18	15	15	18	15	14	15	17	15
Book-keeping and Records... ...	20	18	15	18	18	15	15	15	15	15	16	16	15	18	20	15	16	15	18	15
Dairy Herd ... ... (100 points)																				
Breeding, system of...	25	20	25	20	20	25	15	20	20	20	20	20	20	18	15	20	20	20	15	18
Type and condition	30	23	25	25	25	30	20	20	17	25	25	25	18	25	14	18	16	17	18	20
Bull	25	25	25	25	25	25	15	22	25	25	25	25	25	20	...	25	25	25	15	...
Pigs (breed and condition) ...	20	10	20	18	20	15	20	20	15	18	18	20	16	20	18	20	20	18	18	15
Pasture ... ... (100 points)	60	56	49	50	56	49	48	49	53	51	51	51	47	51	49	37	49	50	46	50
Fodder Crops—																				
Freedom from Disease	3	3	3	3	3	3	3	3	3	3	3	3	3	*Nil*	3	*Nil*	Trial plots only.	*Nil*	3	3
Freedom from Weeds	7	7	7	5	6	4	6	6	6	7	7	7	5	...	6	...		...	7	5
Cult and Manuring	10	9	8	9	9	7	7	9	9	9	9	9	7	...	8	...		...	10	7
Evenness of Growth	7	6	6	5	5	5	5	4	5	5	5	5	5	...	5	...		...	7	5
Yield	13	10	10	10	10	10	8	8	8	11	11	9	6	...	7	...		...	13	8
Silage—																				
Succulency	20	18	15	18	*Nil*	15	12	18	16	*Nil*	*Nil*	*Nil*	12	16	18	16	12	*Nil*	*Nil*	*Nil*
Mixture	20	18	14	16	20 pts. all for summer pasture	15	15	16	16	...	...	...	16	15	18	16	15	...	...	...
Type of Silage	10	9	7	9		7	5	9	8	...	...	...	5	6	8	8	5	...	...	...
Percentage Waste	20	14	14	15		14	16	18	14	...	...	...	13	14	...	14	11	...	...	...
Hay—																				
Mixture	20	18	18	18	18	18	18	18	18	18	18	16	16	18	18	16	16	18	18	16
Condition	20	18	18	18	18	18	18	16	18	18	18	18	12	16	16	14	14	16	18	16
Amount of Fodder per head ...	20	20	15	15	10	20	15	11	17	12	10	12	14	10	6	5	19	12	7	5
Lay-out and convenience of feeding ...	20	15	10	12	20	10	10	10	12	12	10	15	10	10	14	14	10	10	14	10
Utilisation of Separated Milk for—																				
Pigs	20	20	20	20	20	10	20	20	14	15	20	15	7	7	20	...	20	20	14	20
Poultry	5	3	3	3	3	3	5	3	3	3	3	3	...	3	3	3	3	3	3	...
Butter Fat production per acre	50	22	38	39	21	21	41	15	10	50	37	31	25	21	5	16	3	44	12	...
		acres	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres	acres
Acres used for dairying	...	70	88	70	68	100	50	140	72	40	51	50	120	80	40	250	57	58	50	100
Total points	...	413	403	402	375	374	365	365	359	356	350	344	332	323	319	310	308	303	295	250

Three excellent summer fodder crops: Maize, Elephant Grass and Sudan Grass. Planted January 13, 1931; photo. November 15, 1931; T. Briggs, Byford.

TABLE 4.—POINTS GAINED BY COMPETITORS.

ZONE 4. AGRICULTURAL SOCIETY, BRIDGETOWN.

	H. Noon.	H. E. Kendal.	C. E. White.	J. Hearman.	F. W. Head.	A. Hayward.	A. Lindsay.	C. T. Wilkinson.	F. C. Wiseman.
Lay-out and Convenience	23	20	21	21	20	21	17	21	17
General Management and Sanitation ...	20	20	19	18	16	17	15	18	15
Book-keeping and Records	15	15	8	13	4	4	7	12	10
System of Breeding	21	19	17	18	17	15	13	17	16
Dairy, type and condition	24	22	22	20	22	18	17	20	18
Bull	22	20	22	18	21	22	22	22	17
Pigs	20	14	15	8	5	12	10	8	7
Pasture	53	38	42	40	38	40	37	42	38
Fodder Crops	20	13	5	10	8	...	...	15	10
Silage—									
Succulency	16	17	18	17	19	20	18	...	...
Mixture	17	17	20	18	18	20	17	...	...
Type	7	8	8	8	10	10	8	...	...
Waste	2	12	12	15	11	18	12	...	...
Hay—									
Mixture	18	20	20	18	20	18	17	17	18
Condition	15	18	20	18	20	18	15	15	16
Amount per head	12	20	20	20	17	17	12	10	10
Lay-out for feeding	13	14	15	16	16	15	10	14	12
Utilisation of Skim Milk	23	18	21	20	22	22	22	18	20
Butter Fat production per acre	33	27	21	28	30	22	20	20	23
Total	374	352	347	344	334	329	291	269	247

TABLE 5.—POINTS GAINED BY COMPETITORS.

ZONE 5. AGRICULTURAL SOCIETY, MANJIMUP.

	Mr. and Mrs. Hugo Grimmelt.	W. Kjellgren.	H. C. Barnsby.	A. Kjellgren.	R. Nicol.	W. Cox.	H. Brown.	D. Hunter.	J. Prosser.	G. C. Adams.	J. Rising.	W. H. Campbell.	V. Martin.	A. Eggington.
Lay-out and Convenience	21	20	19	25	15	15	27	17	19	20	15	17	14	20
General Management and Sanitation	24	23	23	23	18	15	25	21	20	21	15	18	15	20
Book-keeping and Records	15	5	7	5	...	5	5	5	10	5	5	3	10	...
Breeding—System of	24	16	18	21	17	13	20	18	15	18	15	16	15	15
Dairy, type and Condition ...	25	18	22	22	18	17	25	20	18	20	22	18	19	18
Bull	22	21	...	21	23	21	24	22	22	19	22	21	23	20
Pigs	10	10	18	10	14	9	10	18	...	5	10	13	11	10
Pasture	45	43	42	43	42	37	46	38	38	40	38	38	36	37
Fodder Crop	...	5	10	5	10	10	27	20	40	20	30	25	20	10
Silage—														
Succulency	20	20	20	15	20	20	...	...	...	...	...	...	...	...
Mixture	19	20	20	16	17	20	...	...	...	...	...	...	...	...
Type	10	10	10	8	6	18	...	...	...	...	...	...	...	...
Condition	12	18	16	14	10	17	...	...	...	...	...	...	...	...
Hay Mixture	17	19	17	15	20	17	19	18	17	18	17	15	14	17
Condition	17	18	20	15	16	18	20	14	19	17	15	15	17	13
Amount per Head	18	20	20	17	20	20	15	11	17	15	12	10	12	13
Lay-out for Convenience	16	18	15	18	16	15	20	16	15	15	15	16	15	15
Skim Milk	20	21	22	20	22	20	23	20	13	20	22	20	22	18
Butter Fat per acre	30	23	37	24	31	21	20	38	18	22	18	22	22	11
Total	365	358	356	337	335	328	326	296	281	275	271	267	265	237

TABLE 6.

BETTER DAIRYING COMPETITION.

ZONE 7.—AGRICULTURAL SOCIETY, DENMARK.

	Maximum Points.	F. C. Smith.	A. G. Pomeroy.	L. Hargrave.	P. Berridge.	E. A. Russell.	J. Illsley.	T. Minchin.
1. Farm Management ... ... (75 points)								
(a) Lay-out and Convenience	30	25	25	20	20	27	20	18
(b) General Management, including Sanitation, etc.	25	25	20	20	20	25	20	17
(c) Book-keeping and Records	20	16	...	10	13	15	10	10
2. Dairy Herd ... ... (100 points)								
(a) Breeding—System of	25	20	20	15	15	20	20	20
(b) Dairy Type and Condition	30	28	25	30	24	30	30	25
(c) Bull (give particulars of breeding and production ancestry)	25	25	25	15	15	25	25	25
(d) Pigs—breed, condition, etc.	20	18	17	12	18	12	18	12
3. Pasture and Fodder Crops ... (100 points)								
(a) Pasture	60	51	49	47	43	44	49	42
(b) Fodder Crops :—								
Freedom from Disease	3	3	3	3	3	3	...	3
Freedom from Weeds	7	7	6	7	7	7	5	7
Cultivation and Manuring	10	9	6	7	7	9	7	7
Evenness of Growth	7	6	5	6	6	7	...	...
Yield	13	13	8	6	10	12	...	...
4. Fodder Conservation ... ... (150 points)								
(a) Silage :—								
1. Succulency	20	15	18	15	15	...	15	...
2. Mixture	20	16	18	18	17	...	16	...
3. Type of Silage	10	8	8	8	6	...	8	...
4. Percentage Waste...	20	12	18	10	13	...	13	...
(b) Hay :—								
1. Mixture	20	20	18	18	19	18	16	18
2. Condition	20	18	18	18	18	19	16	18
(c) Amount of Fodder conserved per head ...	20	18	18	12	15	12	8	10
(d) General Lay-out for convenience in feeding	20	18	16	12	15	18	16	15
5. Utilisation of Separated Milk for Pigs, Poultry, etc. ... ... (25 points)								
(a) Pigs	20	15	20	12	16	15	16	15
(b) Poultry	5							
6. Butter Fat Production ... ... (50 points)	50	33	24	42	25	26	15	14
Total	500	417	385	363	360	344	343	276

TABLE 7.—POINTS GAINED BY COMPETITORS.

IRRIGATION ZONE.—HARVEY.

	Maximum Points.	R. Hanks.	R. O. Hayward.	C. Heppingstone.	L. Prince.	W. Shaw.	Evans Bros.	R. Ibbotson.
Lay-out and Convenience of Buildings, etc. ...	30	22	24	26	23	22	18	18
Lay-out of Irrigation Scheme	10	8	8	7	9	8	7	7
General Management and Sanitation	20	16	17	18	16	17	13	15
Control of Water	20	6	5	5	13	20	5	9
Condition of Channels and Drains	10	7	8	8	8	9	7	5
Book-keeping and Records	20	15	20	15	20	20	15	15
Breeding—System of	25	25	20	15	22	22	15	20
Dairy Type and Condition of Stock	30	25	25	23	25	25	20	22
Bull—Breed and dairy type	25	25	23	25	25	25	20	22
Calves—Condition and Rearing	20	20	20	14	20	20	18	18
Pasture	...	24	32	36	32	16	32	30
Eveness of Growth	...	17	22	26	22	8	24	20
Nutritive Value and Mixture	...	13	14	14	18	10	14	14
Freedom from Disease	...	15	20	20	20	15	20	20
Freedom from Weeds	...	12	16	18	18	12	18	16
Fodders Freedom from Weeds	...	5	*Nil*	*Nil*	...	3	*Nil*	*Nil*
Cultivation and Fertilising	...	10	...	...	...	7	...	...
Evenness of Growth	...	4	...	...	...	3	...	...
Yield or Condition	...	9	...	...	...	7	...	...
Silage	...	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*	*Nil*
Hay—Time of Cutting	10	10	10	10	5	9	9	*Nil*
Mixture	20	18	18	18	12	18	16	...
Condition	20	18	18	18	16	16	17	...
Protection	10	10	10	10	...	10	10	...
Amount of Fodder per head	20	20	10	13	5	10	9	*Nil*
Lay-out and Convenience for feeding	10	8	8	8	4	8	8	4
Skim Milk—Pigs	15	15	9	...	2	4	10	13
Poultry	5	3	3	3	3	3	...	3
Butter Fat, yield per acre	50	33	46	50	34	17	39	19
		acres	acres	acres	acres	acres	acres	acres
Area devoted to Dairying	...	50	68	45	65	200	40	30
Totals	...	413	406	400	372	364	364	290

CHAMPION DAIRY FARM.

The following competitors were eligible to compete for the Champion Prize offered by Cuming Smith & Mt. Lyell Farmers' Fertilisers, Ltd., being the First Prize winners in each Zone:—

P. Rose, "Yeeralla," Burekup.
S. F. Russell, "Wendowie," Serpentine.
R. Hanks, "Sarnia," Harvey.
F. C. Smith, Group 41, Denmark.
Mr. and Mrs. Grumpelt, "Woodlawn," Manjimup.
A. Oldfield, Group 6, Forest Grove.
H. Noon, Katterup.

Judging was conducted by the Superintendent of Dairying, Mr. G. K. Baron-Hay, in order to ensure uniformity as between Zones, and farms were visited during the period April 5th to 21st, 1932.

The results are set out in the following table:—

TABLE 8.—POINTS AWARDED FOR CHAMPION PRIZE.

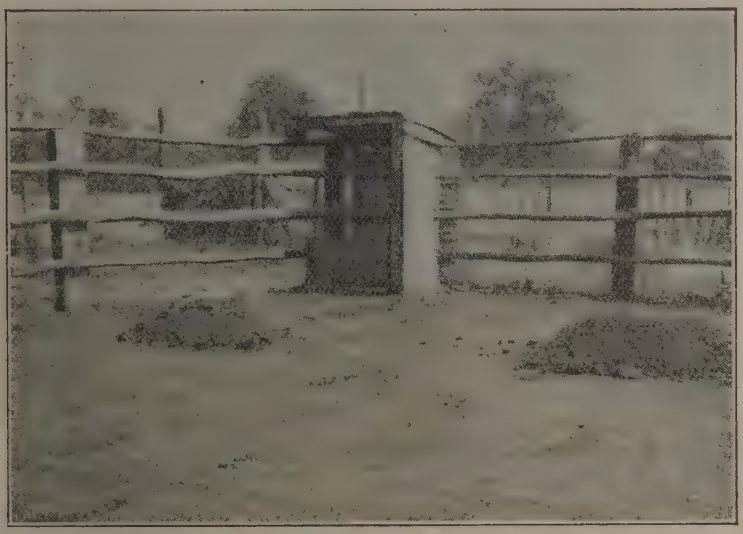
	Maximum Points.	P. Rose.	S. F. Russell.	R. Hanks.	F. C. Smith.	Mr. and Mrs. H. Grumpelt.	A. Oldfield.	H. Noon.
1. Farm Management ... ... (75 points):								
(a) Lay-out and Convenience	30	29	26	24	20	20	26	26
(b) General Management, including Sanitation, etc.	25	25	23	19	19	18	21	24
(c) Book-keeping and Records	20	20	19	14	17	15	17	15
2. Dairy Herd ... ... (100 points):								
(a) Breeding—System of	25	25	20	23	21	23	21	23
(b) Dairy Type and Condition	30	25	23	25	22	23	19	21
(c) Bull (give particulars of breeding and production ancestry)	25	25	25	25	20	25	20	25
(d) Pigs—breed, condition, etc.	20	18	13	14	17	10	12	14
3. Pasture and Fooder Crops:								
(a) Pasture	60	55	53	*90	50	45	50	53
(b) Fodder Crops	40	20	40	25	32	...	25	33
4. Fodder Conservation ... ... (150 points):								
(a) Silage:—								
1. Succulency	20	18	16	...	15	†25	18	16
2. Mixture	20	17	16	...	16	25	18	17
3. Type of Silage	10	9	7	...	8	20	9	7
4. Percentage Waste	20	10	13	...	12	25	14	2
(b) Hay:—								
1. Mixture	20	20	18	*28	18	17	18	15
2. Condition	20	18	18	*28	17	17	18	18
(c) Amount of Fodder conserved per head ...	20	10	5	9	20	12	19	4
(d) General Lay-out for convenience in feeding	20	20	18	18	15	17	16	17
5. Utilisation of Separated Milk for Pigs, Poultry, etc.—(25 points):								
(a) Pigs	20	20	...	14	18	12	15	14
(b) Poultry	5	3	3	3	...	...	3	3
6. Butter Fat Production per Cow—(50 points):	50	50	39	48	50	42	26	34
Total	500	437	‡411	407	407	391	385	381

* Irrigated farm. No silage considered necessary. † Silage in place of Fodder crops. ‡ Whole Milk supplier. No pigs reared. Allowance made—16 pts.

Judging was extremely difficult owing to the various methods of management adopted by farmers which are dependent to a great extent on the climatic conditions. For instance, some farmers relied on adequate supplies of silage in place

of summer crops; the owners of irrigated farms considered silage unnecessary, etc. Where the management, however, was in the opinion of the Judge responsible for the provision of adequate fodder reserves, due credit was allowed in allotting points.

It is not proposed to give detailed information regarding the farms owned by the various competitors, as this already has been published by the Judges in presenting their reports on the Zone Competitions. An effort has been made, however, to glean information from the competition which will be useful to readers in the conduction of their own farms.



Good management on Mr. S. F. Russell's Farm. Manure is removed daily and carted to fields weekly. Phosphatic lick always available in sheltered bin.

1.—FARM MANAGEMENT.

The layout of the various farms in the competition show the need for careful planning before a property is developed. It is noticeable that where the holdings have been developed by their owners from the virgin state, particularly in Zones 3 (Margaret River), 5 (Manjimup), and 7 (Denmark), the layout is usually good. The farms owned by Messrs. P. Rose, S. F. Russell, and H. Hanks also exhibit careful planning.

The general layout to be aimed at is one that will lend itself to controlled grazing, having in mind the necessity for small paddocks which should be accessible from centrally placed races with provision for the watering of stock.

In general, the records being kept by farmers do not give sufficient data to enable the owner to ascertain what departments of his farming activities are profitable. The dairy farm should be essentially a mixed farm embracing the production of butter fat and pigs, with poultry and perhaps cropping as sidelines. Records should be kept showing the expenditure required by each department and also the returns obtainable from the sale of that produce. In only a few instances were complete records being kept regarding the weight of milk being yielded by the individual cows in the herd.

2.—DAIRY HERD.

The winning farm, "Yeeralla," owned by Mr. P. Rose, is conducted on lines which would be considered suitable for the majority of dairy farms in the South-West. This farm consists of 600 acres of undulating country, 400 acres being cultivated. As the area was taken up in the virgin state, provision was made for fencing so that paddocks would be square or rectangular, there being now 24 paddocks for grazing—5 of 5 acres and 19 of 10 to 20 acres each.

The herd consists of 74 cows, being almost entirely pure bred Jerseys bred by the owner during the last 14 years.

The policy in the development of this herd has been a consistent one of breeding for production by the use of herd sires from tested cows in the "Melrose" Stud owned by Mr. W. Woodmason, Victoria.

The herd of 74 cows averaged 252 lbs. butter fat without allowances during the year, which in view of the fact that very little purchased concentrates are fed is extremely good.

The foundation of the herd was laid in 1920 by the purchase of 8 cows and the bull "Reveller of Melrose (1804)" ex "Graceful Duchess 14th" by "Golden Fern's Viscount."

The following is a record of the bulls that have assisted in maintaining and improving the high standard of production in this herd:—

Name of Bull.	Dam.	Production.	
		Average Test.	Butter Fat.
		%	lb.
1920—Reveller of Melrose ...	Graceful Duchess 14th ...	6·16	466
1923—Grafter of Melrose ...	Vanilla 5th of Melrose ...	5·17	452
Colonel of Melrose ...	Blossom 5th of Melrose ...	6·29	467
1927—Romeo of Melrose ...	Vanilla XI. of Melrose ...	5·59	424
Raleigh of Melrose ...	Jessie 36th of Melrose ...	5·89	269 H.
1929—Sultan of Melrose ...	Graceful Duchess 41st... ...	5·84	354 J. 3
Melrose Clarion ...	Jessie 36th of Melrose ...	5·89	269 H.
1930—Melrose Liberty ...	Werribee Fancy's Clementine 2nd	...	605
Average Butter Fat Production of Dams, with allowances ...			461

It is pleasing to state that the policy adopted by Mr. Percy Rose, as briefly outlined above, is that followed by practically all competitors, for out of the 67 bulls owned by competitors no less than 61 are pure bred and 41 are not only pure bred but ex tested dams.

It is interesting here to compare with this the results which have been achieved in this State in the elimination of poor quality bulls since the initiation of "The Dairy Cattle Improvement Act, 1924," which may be briefly shown as follows:—

1924—Percentage of pure bred bulls .. .. .. 23 per cent.
1931—Percentage of pure bred bulls .. .. .. 53 per cent.
Percentage of pure bred bulls owned by competitors .. 91 per cent.

The results being achieved by such practical dairymen as those leading in each Zone must commend themselves to all dairy farmers throughout the State,

Mr. P. Rose's Herd of Pedigreed Jersey Cows, "Yeeralla," Burekup.

and it is hoped that the use of "Standard" bulls, i.e., bulls ex tested dams, will continue to increase.

The far-reaching effects of a stud bred as above is also indicated in the herds of leading competitors, as Mr. H. Grumpett, winner in Zone 5, and Mr. B. Langridge, second to the champion, are both building up their herds on stock obtained from the "Yeeralla" stud.

Two-year-old Heifers, Mr. P. Rose, Burekup. Progeny of Romeo of Melrose and Raleigh of Melrose.

TABLE 9.—PER CENT. OF "STANDARD" BULLS.

Zones.	No. Bulls ex Tested Dams.	Average Production of Dams—without allowances.
1	6	387 lbs. butter fat.
2	3	491 „ „
3	11	395 „ „
4	4	391 „ „
5	13	352 „ „
7	4	350 „ „
Average	41	382 lbs. butter fat

Per cent. "Tested Bulls" owned by competitors—67 per cent.

PIG-BREEDING.

The majority of competitors were paying attention to the breeding of pigs as a side-line, 56 out of the 62 competitors owning breeding sows.

The following table shows a comparison of the number of sows to milch cows:—

TABLE 10.—COMPARISON OF NUMBER OF SOWS TO COWS.

——	No. of Cows.	No. of Sows.	No. of Sows to Cows.
Zone 1	222	13	1 : 17
Zone 2	184	41	1 : 4·5
Zone 3	Information not available.		
Zone 4	158	29	1 : 5·4
Zone 5	290	39	1 : 7·7
Zone 7	96	19	1 : 5
Average	...	...	1 : 6·7

It will be noticed that in Zone 1 only one sow on the average is kept to 17 cows. This may be accounted for by the fact that four out of the seven competitors in Zone 1 supply the metropolitan area with whole milk.

In the remaining zones the number of cows varies from 4½ to 7½ per sow, which is usually the number found most profitable in that the skim milk produced by these cows is sufficient to rear the progeny of the sows.

A weakness noticed in the feeding of skim milk to pigs was that the necessary grain required to top off baconers or porkers is in many cases not supplied. This can be grown on the farm, and good crops of barley or peas can be grown in the South-West for feeding to pigs.

The winner, Mr. P. Rose, has developed on sound lines the pig-breeding side of dairy farming. Peas are grown for feeding and topping off baconers and porkers, the sows being grazed through the greater part of the year. Barley or rape is sown for grazing, while the fattening pigs—in addition—receive skim milk with grain grown on the farm.

As in the breeding of dairy stock so in the breeding of pigs, competitors in every instance realise the importance of a pure bred boar.

The distribution of breeds is shown in the following table, and the large predominance of the Berkshire and Tamworth breeds will be noticed.

Table 11.—BREEDS OF PIGS OWNED BY COMPETITORS.

Number of Farmers.	Breed of Sows.	Pure Bred Boars.
27	Berkshire x Tamworth	Middle Yorkshire (4)
14	Berkshire	Berkshire (14)
6	Berkshire x Middle Yorkshire	
4	Tamworth	
2	Tamworth x Middle Yorkshire	
1	Middle Yorkshire	
1	Large Black	
1	Large Black x Middle Yorkshire	

3. *Pasture and Fodder Crops.*—The type of pasture generally, except on the irrigated areas or on specially damp summer land, was composed of annual plants, the predominating clover being Subterranean Clover which was replaced in the Busselton area by Drooping Flowered Clover. This clover has revolutionised the development of light sandy soil overlying clay and which is extremely wet in the winter months, and was first brought into prominence in this district by Messrs. Reading Bros. at Newtown.

Cheap Land Development, Reading Bros., Newtown. Drainage essential. First year after sowing with Drooping Flowered Clover and 1 bag of superphosphate per acre.

In the development of land with the use of this clover drainage is the first consideration, and can be economically carried out by means of the Martin Ditcher. The area is then sown with Drooping Flowered Clover seed, either in the form of clean seed, or seed in chaffed material which has been swept from the fields, or clean seed which has passed through the animal and is applied to the land mixed with farmyard manure. This latter method is the one favoured by Messrs. Reading Bros., who yard their cows each night during the summer months and whilst they are being fed hay. The droppings from these cows contain large quantities of seed, the manure being pulverised by the continued tramping of the cows, and is sown early in autumn.

The remarkable results obtained by the sowing of this clover are shown in Illustrations 6-8.

Second year after annual top-dressing with 1 bag superphosphate.

On the older areas there are indications that the development of permanent pasture plants will gradually extend throughout the South-West, the soil in the initial years after clearing being too low in nitrogen content to make the cultivation of high-fertility perennials, particularly the Rye Grasses, practicable.

From the above it will be conceded that the provision of succulent fodder during the summer months is essential for successful dairying in the South-West at the present stage of development. In general, the results of this Competition show that too little attention is paid to summer fodder crops. Only two-thirds

After third annual application of 1 bag of superphosphate per acre. Growth almost entirely Drooping Flowered Clover.

of the competitors grew fodder crops of any kind, and in very few instances was the area adequate to provide succulent feed for the herd, the area sown ranging from one-quarter acre to six acres. The area planted bore no relation to the number of cows being milked and generally, during the past dry summer, stock have suffered from the lack of succulent fodder.

The acreage of summer fodder grown in each zone is shown in the following table:—

Table 12.—ACREAGE OF GREEN FODDER PER COW.

——	Number of Cows.	Summer Fodders.	Acres of Summer Fodders per Cow.
		acres.	acre.
Zone 1	162	14·50	0·09
Zone 2	42	3·25	0·08
Zone 3	200	24·75	0·12
Zone 4	84	11·50	0·14
Zone 5	180	23·25	0·13
Zone 7	96	30·25	0·32
Average all competitors	...	...	0·14

The farms where silage has been made in order to provide succulent fodder, and also farms where irrigation is possible, have been omitted from Table 12.

Taking into account the wide areas over which the farms were scattered in each zone, it is remarkable that the average acreage of summer fodders per cow is as

constant as that shown in the table, and, it will be conceded, is far below a desirable area, at least half an acre being required unless ample silage is conserved.

It is true that the provision of silage might account for the small area of summer fodders grown, but a perusal of the notes on fodder conservation given below will show that, on the average, the reserve of fodder for the summer months has been quite inadequate.

Mr. S. F. Russell's crop of Maize, Serpentine. This farmer leads in the production of summer fodder, growing Lucerne, Cow Peas, Elephant Grass, and Maize.

4. *Fodder Conservation.*—Fodder conservation was considered by the Committee responsible for organising the competition as likely to be *the most important factor* in the more economical production of dairy produce in Western Australia. Throughout the greater portion of the South-West, there is a period of at least four months during which succulent fodder may be lacking and should be provided either in the form of fodder crops or as conserved fodder in order to maintain production during that period.

The dairy farm practice of a few years ago whereby cows were milked during the rainy season from July to December is only found in isolated cases, and a system whereby production is spread throughout the year is now being found profitable and is advocated. This will greatly assist butter manufacturers to reduce costs of manufacture and also will tend to enable a larger return to be made to the farmer, by reason of the fact that importations would not be necessary during the lean months as at present, and export would not be confined to the flush period of the year only.

The results of the competition show that further conservation of fodder is essential for the interests of the dairying industry. Even among the competitors, some of whom may be assumed to be the leading dairy farmers in their district, the conservation of fodder is obviously the weak point in the management of the farms.

Table 13 sets out in a concise manner the average tons of fodder conserved per cow in each zone, and, for comparison, the tons of fodder conserved by a leading farmer in that zone—

TABLE 13.—AVERAGE TONS OF FODDER CONSERVED COMPARED WITH HIGHEST RESERVE IN EACH ZONE.

	Cows.	Hay.	Silage.	Reserve per Cow.		Reserve per Cow calculated as Hay.*
				Hay.	Silage.	
Zone 1—Average ...	222	170	55	0·76	0·24	0·84
T. Briggs	**32**	**130**	**...**	**4·06**	**...**	**4·06**
Zone 2—Average ...	184	142	144	0·40	0·40	0·53
P. Rose	**74**	**85**	**80**	**1·15**	**1·08**	**1·51**
Zone 3—Average ...	360	403	340	1·12	0·90	1·42
A. Oldfield	**16**	**50**	**40**	**3·12**	**2·50**	**3·95**
Zone 4—Average ...	158	194	119	1·23	0·75	1·48
H. E. Kendall ...	**25**	**52**	**18**	**2·08**	**0·72**	**2·32**
Zone 5—Average ...	290	444	205	1·53	0·71	1·76
W. Kjellgren ...	**19**	**40**	**35**	**2·10**	**1·84**	**2·71**
Zone 7—Average ...	96	156	68	1·62	0·71	1·85
A. G. Pomeroy ...	**20**	**50**	**16**	**2·50**	**0·80**	**2·80**
Irrigation	192	96	...	0·50	...	0·50
R. Hanks	**18**	**23**	**...**	**1·29**	**...**	**1·29**
Average—All Zones	1,502	1,605	† 931	1·06	† 0·71	1·33

* 3 tons Silage equivalent to 1 ton Hay. † Irrigated Zone omitted.

It will be noticed that the average conservation of fodder ranges from ½ ton per cow to 1.85 tons per cow, and it is also instructive to notice that the highest conservation of fodder is found in areas recently opened up as at Denmark, Margaret River, and Manjimup.

The table also shows that in each zone farmers are found who, in many instances, conserve three times as much fodder per cow as the average for that zone, *and in each case these farmers are among the leaders in their district.*

The average conservation of fodder for all farmers in the competition was 1.33 tons per cow, the reserve being calculated as hay where 1 ton of hay is equivalent to 3 tons silage. It is considered that 2½ tons of conserved fodder as hay is necessary for safety and ample feeding. This quantity may be conserved as 1½ tons hay and 3 tons silage per cow.

It will be noticed that, although nearly all competitors conserve some silage, the quantity conserved is far too small, averaging less than ¾ ton per cow. It is hoped that all farmers will make a strenuous endeavour during the coming season to ensure that larger tonnage of silage is made, especially in view of the ease with which this form of fodder may be conserved in South-West districts.

In the majority of cases, hay had been cut when too mature. This was especially noticeable in the case of cereal hay which should be cut when the plant is in flower. The actual yield per acre in weight is less at this stage, but the quality of the hay is superior and supplies more digestible material than when cut at a later stage.

A 3-ton crop of Meadow Hay, L. Pearson, Benger. Cut at flowering stage, carted within two days.

In the case of Meadow hay, where this contains a large proportion of Subterranean Clover, the quality was usually good, as farmers have learnt by experience that, unless cut before fully mature, difficulty is found in harvesting. Where, however, a large percentage of grass was present in the material to be cut, this was invariably harvested when too mature.

A well-built 40-ton silage stack. Dr. A. G. Abbott, Eastbrook. Bags of earth held in position by wire threaded through end; centre filled with earth.

BUTTER FAT PRODUCTION.

Butter Fat Production.

The competition has brought out interesting information regarding the butter fat production per acre in various districts, and also the butter fat production per cow under varying conditions.

Table 14 shows the average production of butter fat per acre for the various zones compared with that of the leading competitor in that zone.

TABLE 14.—BUTTER FAT PRODUCTION PER ACRE.

Zone.	Area devoted to Dairying.	Average number of Cows.	Butter Fat per acre.
	acres.		lb.
Zone 1—Average	138·9	31·7	53·4
S. F. Russell	121	38	68·3
Zone 2—Average	247·7	43·5	50·4
P. Rose	540	74	34·5
Zone 3—Average	81·5	19	37·9
A. Oldfield	70	23	47·7
Zone 4—Average	96·1	17·6	35·1
H. Noon	90	22	45·9
Zone 5—Average	92·4	17·1	35·5
H. Grumpelt	160	29	42·3
Zone 7—Average	57·4	13·7	45·4
F. C. Smith	50	10	55·5
Average—			
Unirrigated Farms ...	119	23·7	43·0
Irrigated Farms	71·1	27·4	100·3

The butter fat production per acre varies from an average of 35.1 lb. to an average of 53.4 lb. on unirrigated farms, whilst the average return per acre on irrigated farms was 100.3 lbs. butter fat. Individual returns, however, were considerably in excess of this, Mr. S. F. Russell's herd averaging 68.3 lbs. butter fat per acre, while that of Miss Heppingstone on an irrigated farm at Harvey averaged 148 lbs. butter fat per acre. The average yield per acre for all the competitors was 43 lbs. butter fat.

The value of irrigation as a factor in cheapening the cost of production is brought out, provided the cost of irrigated land is not relatively too high in comparison with that of unirrigated land.

Assuming that the competitors on the average are fair representatives of leading farmers in the industry, then as far as production is concerned the relative value of a dry farm as compared with an irrigated farm would be as 43 : 100.

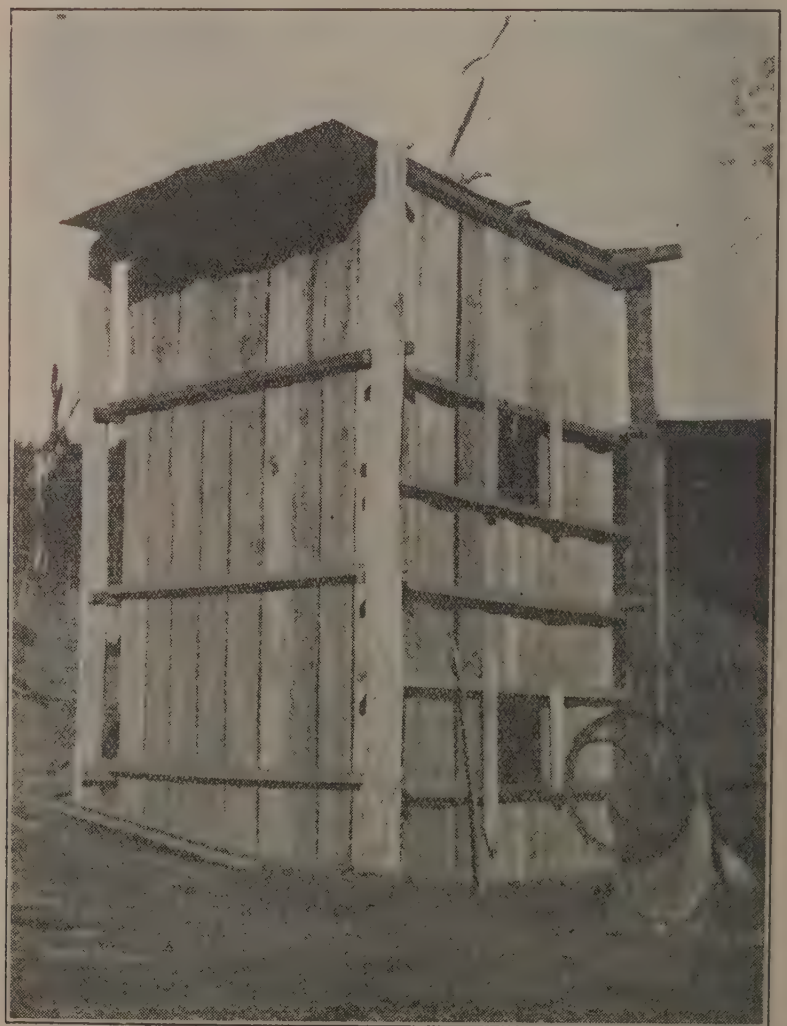
The table also indicates that, on the average, larger returns per acre are obtained where the farm is small and intensely cultivated and managed. This is particularly the case in the newer areas opened up by the Group Settlement Scheme.

Table 14 also shows that the average size of the land devoted to dairying is 119 acres.

The information obtained by the Judges also throws valuable light on the area of land in varying districts necessary for the maintenance of a milch cow. It must be borne in mind, however, that, in addition to the milch cow, this area would support yearling heifers, a bull and the horses necessary to work the farm.

Table 15 shows that on unirrigated areas approximately 5 acres per milch cow are necessary, although in different zones the figures range from 4.2 up to 5.5 acres per cow. On irrigated farms the acres per cow were as low as 2.59.

Assuming that the total capital outlay per cow should not exceed £60, then unirrigated land such as that obtaining on the average dairy farm would be approximately £12 per acre, while the irrigated land would be worth approximately £25 per acre.



A cheap face-cut silo. W. Cox, Jardee. Reduces waste and permits material being chaffed.

TABLE 15—ACRES PER MILKING COW.

Zone.	Average number of Cows in Herd.	Acres in Farm used for Dairying.	Acres per Cow.
1	31·7	138·9	4·38
2	43·5	247·7	5·10
3	19	81·5	4·28
4	17·6	96·1	5·47
5	17·1	92·4	5·43
7	13·7	57·4	4·19
Average— Unirrigated Farms ...	23·7	119·0	4·91
Irrigated Farms ...	27·4	71·1	2·59

The foregoing notes have set out briefly the outstanding points in connection with the Better Dairying Competition inaugurated by the Australian Dairy Council, which may be summarised as follows:—

1. The necessity for planning a dairy farm prior to development, with a view to practising rotational grazing with small fields.
2. The necessity for a more efficient system of book-keeping and records.
3. The type of dairy cow on the farms inspected was good, and owners appreciated the value of breeding for production through the use of a pure-bred bull ex a tested dam.

Feeding Silage. H. C. Barnsby, Clovelly Farm, Pemberton.

4. Generally, pig-raising was being practised, but it is necessary to provide for grazing of sows and the feeding of home-grown grain for the topping off of porkers and baconers. The breed of pigs being kept was good.
5. Throughout the South-West, interest in pasture development is general, and efforts are being made to practise control grazing as fast as expenditure on fencing and fertilisers will permit.

6. The pasture at present consists almost entirely of annual species, particularly legumes.
7. Top-dressing with at least 1 cwt. superphosphate is very general. Individual farmers are now experimenting with heavier dressings and with the addition of nitrogenous fertilisers.
8. The cultivation of fodder crops is being neglected. Where no silage is provided, at least ½ acre per cow is recommended; the average area grown was a quarter of this.
9. *Fodder Conservation.*—This is the most neglected factor in profitable dairy farming. The average conserved fodder calculated as hay was 1.33 tons per cow. In order to provide ample fodder during the lean period, 2½ tons are considered necessary, 1½ tons of which should be hay and 3 tons silage.
10. Hay, generally, is cut when too mature.
11. The cultivation of lucerne should be encouraged, failure being due to two main reasons:—
    (a) Non-inoculation of seed with the necessary soil bacteria;
    (b) Sowing during the autumn when the young plants are destroyed by the attacks of the Lucerne Flea and Red Mite.

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1—1

REPORT ON A SHIPMENT OF LIVE STOCK FROM ENGLAND TO AUSTRALIA WITH SUGGESTIONS FOR REFORM.

H. S. Rudduck,
Veterinary Surgeon, Melbourne, Victoria.

The shipment of stock brought out to Australia in the s.s. "Matakana," which left London on 7th January, 1930, arrived at Western Australia 8th February (31 days out), and at Melbourne 17th February (40 days out), comprised 17 head of Guernsey cattle, 18 Southdowns, and 2 head of swine, for which I was personally responsible. The other stock, consisting of Shorthorns, Aberdeen Angus cattle and Tamworth British Black and Berkshire pigs were fed and attended throughout the voyage, under my advice.

Accommodation, Cattle.—Special boxes were provided, made of softwood with boards nailed inside, and two doors—one double (top and bottom) in front and a large single back door. These boxes are lashed to the deck with wire ropes which come right over the top. It is practically impossible to make use of the doors, especially the back one, which is also jammed against the rails of the ship. This door is supposed to be used for cleaning purposes throughout the voyage. One soon realises that the boxes have been designed by people who have no practical knowledge of transport of stock at sea. The wire ropes also interfere with carrying feed and water. As all my stock were quiet, I got over this difficulty by taking the doors off the hinges, leaving a back bar in position, and shortening the head ropes; but it made unnecessary work, because the door had to be lifted off and on each time the boxes were cleaned out, and frequent cleaning out is essential, especially in the Tropics. This defect could be remedied by having a sliding double door—the bottom half need only be moved for cleaning out; but in very hot weather as, for example, in the Red Sea where every bit of ventilation is wanted, the top and bottom sliding doors could be moved across, and two or three bars would prevent the animal from getting out, even if it slipped the halter or came unfastened.

With regard to inside nailing, a good sea striking the box would easily carry the boards away, especially as the timber is green and shrinks in the Tropics. They would be safer if nailed on the outside, and a few pieces inside would protect the stock. The floors are so constructed that there is no provision for drainage. With cows it is bad enough, but with bulls it is a great deal worse, as the urine saturates the bedding from the middle of the box backwards. Not only does this increase the work, but it wastes quite a lot of bedding, and in hot weather, unless the boxes are frequently cleaned, and the animals kept free from manure, etc., caking and soaking into the skin, it results in scalding, lifting the hair, giving a sorry appearance on disembarkation.

The floor should consist of strong timber from 3—4 inches wide with 1 inch spaces between, so that the urine gets away to the deck as quickly as voided. In the Tropics, this floor would not only allow better circulation of air all around the beast even when lying down, but, as hosing with sea water is often necessary, the water would drain off, and the surroundings would be kept more sanitary, with less work.

The wire rope lashing should be adjusted to interfere as little as possible with the work entailed in carrying food and water. There is so much really necessary work with stock on board ship that every detail is important.

Accommodation, Sheep.—The principal defect in the sheep boxes was the floors. They were so constructed that all the droppings and urine accumulated in the straw. Under ordinary temperatures, one could not have a better cause for foot rot, but in the Tropics the trouble is intensified. This accounts for so many sheep landing in Australia being seriously affected with this disease. Sheep should have a batten floor similar to our shearing shed floors. No bedding is required; in fact, they are better without it. The excretions would then fall on to the decks, and the sea hose pipe would clear everything away without trouble. Hardwood battens, 2 x 1, spaced about ¾in. apart, would answer well, and this floor should be about 6in. off the deck.

It is a common practice in Australia to put large numbers of sheep in sheds (shearing sheds). The floors of these sheds, being constructed on similar lines to those recommended in this report, allow the sheep to remain in for an indefinite period without any cleaning out being necessary. It is therefore evident that sheep would travel cleaner, cooler and safer under the conditions advised, instead of in boxes bedded with straw, as at present.

Accommodation, Swine.—The same remarks are again applicable. Floors faulty—no provision for drainage. Not only is work increased, but in hot weather (and pigs suffer a great deal from heat) an open floor would make an appreciable difference. There should be a movable board at each end of the pen for cleaning purposes. Wooden troughs are unsuitable. They are often smashed or eaten beyond repair. Pigs also require two troughs. One should be used for fresh water, the other for food, with a shoot to it from the outside. The iron bars should be made difficult to move, and not be interfered with on the voyage. We were fortunate to land the number we did, as more than one pig got out and did a promenade, generally finishing in or near the cook's galley. One Berkshire pig in particular, whenever he got tired of his quarters, would lift the bars out with his snout and walk around the deck. If the animal had headed straight for the side, it would have been serious for the insurance companies.

Diet, Cattle and Sheep.—The usual scale of food was adhered to when ordering, viz., hay 15lb., chaff 2lb., crushed oats 2lb., linseed cake 3lb., bran 3lb.; and for sheep the same, but smaller, quantities. When considering the diet, it should be remembered that the change of temperature and climate is extreme in a very short space of time. For example, an animal leaving England in December is leaving practically in mid-winter, with all its winter coat on—plenty of fat inside and out. In less than three weeks it is subjected to a climate as regards temperature and humidity, that is a great deal worse and more trying than any mid-summer day in England. For example, 20 days after leaving London the sea water temperature was 84 degrees, and the only breeze was that made by the movement of the ship. If a following wind is experienced, it of course intensifies the conditions. In must be remembered that the animals are confined to a narrow box, with a minimum of ventilation. The heat is steamy and the atmosphere breathless. These conditions demand the most careful feeding, and what is there safer or better for stock leaving England than good English meadow hay? Even if the animals are sent via the Cape instead of the Suez Canal, the ship has to go through the Tropics, which means extremes of conditions, although probably not so severe as through the Red Sea. Consequently, if animals are fed with a liberal supply of concentrates, or with food that is liable to give trouble to the digestive organs, the blood becomes surcharged with effete poisonous materials. A strain is put on all excretory organs; probably the central nervous system becomes deranged, resulting in acute congestion of the lungs, which is followed by heart failure and death. As

a matter of fact, it would be extremely easy for a mortality to take place in this way, and the attendant believe he was doing the best for the stock, to land them in what is commonly known as Show condition. If chaff (chopped) is used, it should always be fed dry. Wet feed is a frequent cause of digestive disorders. Linseed cake with oats is quite good food for heavy milkers, but on a sea voyage it is really not necessary, and when given with chaff, results (after a few feeds) in the animals wasting most of the food, searching for the cake. Beef cattle and dairy cattle not milking will travel remarkably well and put on condition for stud work, which is hard condition, on meadow hay by itself. Should any other food be deemed necessary, a few pounds daily of crushed dry oats could be given. In this shipment we had a very fine five-year old Shorthorn bull. He was an enormous animal and in Show condition when shipped. Many English experts said we would not only experience trouble with him in the Red Sea, but they did not think he would ever arrive at his destination. To commence with, the attendant of the beef cattle damped the feed, which contained bran, oats, cake and chaff. After a few days, at my request, he was fed dry, and before entering the Red Sea, when the weather commenced to warm up, at my request again, he was fed almost entirely on meadow hay with a small quantity of crushed oats and bran dry.

This animal, in the Red Sea, certainly was hosed several times daily. His joints, on account of his weight, and the rolling of the ship, began to trouble him, until the hosing was commenced, and I am quite certain that even then if he had had the usual feed, it would have been a very serious matter for him, but with the diet he was on, and the liberal use of sea-water, he really did not give us an anxious time at all, and landed in splendid condition, with perfectly clean legs.

Feeding Horses.—Horses should be fed on chaff, crushed oats, and bran, given in a dry condition, and a liberal supply of hay at night. They should have water three times daily before feeding. There were no horses in this shipment, but I have had considerable experience with shipping army horses to South Africa and Egypt, and, on the diet, never had a case of digestive trouble, Colic or Founder, and the horses arrived in good, hard condition.

Feeding Sheep.—The sheep throughout the voyage, were fed entirely on meadow hay and roots. I had some excellent kohl rabbi which lasted until we reached Western Australia. Only a small allowance of roots once daily; but the hay racks were never empty, and the sheep seemed to be eating or cudding about 20 hours out of 24. If roots are sent, the attendant should have a root-cutting machine. The risk of an animal being choked by hand-cut roots is thereby obviated. Also, arrangements should be made with the chief officer for stowing them where they will keep best. All the ewes I brought out were heavy in lamb. They not only landed in good order (two died from the heat, lambing troubles), but since landing the ewes and lambs born *en route* and after arrival have all done extremely well, showing that the diet which was safe was also sufficient.

If used without waste, 4 lb. daily of meadow hay should be sufficient for each sheep.

Feeding Swine.—On every ship there is a good deal of waste food that makes excellent pig food, consequently arrangements should be made for a supply of this, along with the usual food shipped, such as barley, meal, pollard, etc. Only it is essential to inform the cooks that no salt or soda is to get in from the galley, as the result would be fatal.

Hay Nets.—Hay nets should be provided for all stock, not only for purposes of economy (the nets could be filled where the hay is stored and carried to the

stock without loss from wind and rolling), but there is the additional advantage that an animal is not likely to over-eat on hay; therefore, when the captain makes his daily inspection, if there is a good supply of hay in the nets and water in front of the stock and the stalls, etc., are clean, he will know that the animals are getting all the essentials attended to.

With ordinary hay racks for sheep there is a lot of waste, both in carrying hay to them along the decks, and by the sheep when feeding. This could be avoided by hay nets.

Water.—It is most necessary and important that cattle, sheep, and swine should have water in front of them during the entire voyage. In the Red Sea, the S.D. ewes drank over two quarts each daily. The swine also took it freely, and an abundant supply with frequent hosings of sea-water no doubt largely accounted for no mortality with them.

Re Rock Salt, Blood Salts, Treacle, etc.—None of these is necessary. The addition of a little sea-water (which contains a perfect solution of blood salts) to the drinking water is far better than either of the former. As a matter of fact, rock salt is hardly ever touched by stock on the voyage. Treacle is useless, as no wet food is used. It is a good food for cold weather, but not for the Tropics.

Medicines.—A good skin-dressing, easily applied, is essential, as ring worm and skin chafe are common. Liquid paraffin (medicinal) is preferred to linseed oil, and a few fever drenches, laxative drenches, scour or diarrhoea mixtures, eye lotion, wound powder, antiseptic ointment, a pound or two of cotton wool, bandages, and a bottle of veterinary iodine will complete the requirements. As a matter of fact, with careful feeding and ample water, very little medicine is necessary.

Lambing Ewes.—Several of the ewes lambed on the voyage—a great deal of trouble was experienced. In the first place, all the ewes were very fat. Several had won prizes and were shipped in their Show form. They felt the heat in the Red Sea (two out of eighteen in lamb succumbed). In addition, most of them had twin lambs. Not one lambed with a normal presentation or without assistance. This may have been due to loss of tone in the uterus and abdominal muscles from the heat, etc., with the young getting misplaced in their movements. Anyway, the lambs appeared at birth with a mix-up of legs and sometimes heads, and seemed very weak for a few days. Teaching them to drink required not only a lot of patience, but some manoeuvring, as it took some time to get their sea legs and accommodate the suckle to the roll of the ship. I have had calving cases on board ship and think nothing of them, but the lambing of ewes under voyage conditions should be avoided if possible.

Rugging.—I believe that horses, cattle, and sheep would travel in greater comfort, and with less risk, if they were clipped and rugged prior to embarkation. If necessary, a blanket could be used for horses and cattle, as well as a canvas rug. A rug only, or even a good piece of hessian bag, would be sufficient for the sheep. As the ship ran into the Tropics the clothing could be removed, and put on again if necessary if the weather got colder further south.

Stud Work.—It is quite common experience for an importer of stud stock to have trouble with the animals imported in regard to their capabilities at stud. I have often been called in professionally to attend horses, cattle, sheep and swine on account of their inability to perform their work, and almost without exception their condition can be attributed to wrong feeding on the voyage. Taking the

experience of this particular shipment, every animal, so far as we are aware, has landed in vigorous condition, and some of them have gone straight to stud work without any acclimatisation at all. For example, one Southdown ram, as soon as released from quarantine, was mated with 100 stud ewes, and did his work successfully. This "condition" is described as hard condition, and must be distinguished from what is known as Show condition, or, in other words, fat. There is nothing more detrimental for stud work than landing animals in Show condition.

Summary.—I do not think it is generally known that all boxes carrying live-stock to Australia are prevented from landing, but have to be broken up and dumped at sea. This is surely waste. On the s.s. "Matakana" there was an ideal place for carrying stock in the shelter deck. It could have been fitted with the minimum expense. All that would be necessary for sheep is a false floor as already described, laid on the deck in sections. Ordinary sheep hurdles, to which English sheep are accustomed, would keep them in their respective quarters without trouble. Cattle would, of course, necessitate stronger partitions and fronts; but, even so, the actual outlay would be considerably less than the cost of the boxes used at present. Moreover, the greater part of timber used would probably be useful afterwards as ship's timber, and the false floors would not occupy much room if stored for further use, provided the trade warranted it. Some of the ships are even better suited for this plan than the "Matakana," having a good supply of portholes in the shelter deck, so that, with the openings fore and aft, as well as portholes and hurdles between the sheep, openings in the partitions between cattle, together with batten floor off the deck, there would always be a current of air circulating, which could be reduced if necessary.

Costs.—It is reasonable to assume that if these suggestions were acted on there should be an appreciable reduction in the expenses of shipping live stock, and possibly, ere long, in insurance expenses also, as the stock would be carried with a minimum of risk.

In the reduction of expenses there is not only the lessened cost of the simple food and quantities recommended, as also straw bedding (for sheep no bedding is required, and for cattle half of that now supplied would be ample), but a considerable saving would be effected by the lessened cost for cartage, railway charges, dock dues, handling, and many other miscellaneous charges, as well as in the amount of space occupied on board, which probably makes part of the shipping charge.

Further, the cost of bags for foodstuffs in the quantities now shipped, is a considerable item. New bags have to be used—second-hand bags not being allowed on account of the foot and mouth disease. As an instance, bags purchased for my stock cost £27 wholesale. As instancing the waste involved in providing fodder for the voyage in the quantities at present considered necessary, it might be mentioned that I had over 160 bags of chaff untouched. As under the quarantine laws, no foodstuffs can be landed in Australia, the whole of the excess fodders were taken to sea and dumped overboard. The space occupied by the excess fodder must also be regarded as an unnecessary item in the cost, and altogether my experience was such that I felt it incumbent upon me, in the interests of importers of stock, to set out the facts in connection with my experiences so that they might be brought under the notice of those who might be in a position to have alterations made with future shipments.

CHANNEL ISLAND CATTLE—JERSEYS AND GUERNSEYS.

It is not generally recognised, even by the powers that be, that these cattle when on their native soil, are amongst the soundest and the healthiest in the world. For example, I was informed by the veterinary authorities in both Jersey and Guernsey that tuberculosis was practically unknown; that contagious abortion was absolutely unknown; that warbles had never been seen; and that all the Channel Islands were free from foot and mouth disease. They have one disease—Johnne's disease—which gives a certain amount of trouble, and for this a diagnostic agent has been found by Major Dunkin, M.R.C.V.S., the person who has world-wide reputation for work done on canine distemper, in association with Doctor Laidlaw, at the Medical Research Laboratories, Mill Hill, London. This fact is worthy of consideration and would possibly be of more benefit to Australia than the tuberculin test which is now applied twice on cattle practically free from tuberculosis. Please note that these remarks apply to cattle in the Channel Islands, and not to Channel Island stock in England, irrespective of where they are born.

These interesting facts open up some very big questions for Australia. For example, on account of warble fly we are prevented from importing Channel Island stock for every six months out of twelve. Yet the Channel Islands, as already stated, are free from warbles.

Again, although the Islands at present are free from foot and mouth disease, the cattle are quarantined in England, and examined every day by the veterinary officer of the Board of Agriculture and Fisheries, to see if they are free from foot and mouth disease. The risk of infection is from the stock in quarantine, as they are landed in England under special supervision and not allowed to come in contact with any other stock. They travel in specially disinfected conveyances.

Surely it is reasonable to ask that if the cattle landed in England under the supervision of our own veterinary surgeon were conveyed under the same supervision, straight to the ship, that would be sufficient to meet all the requirements and, if so, why, as the Islands are free from warbles, should they not be shifted any time during the year?

If the objection of bad weather is raised, interfering with the delivery of cattle to time, arrangements could be made for the cattle to be on board say 48 hours before sailing from England.

This fact has more than one effect. Firstly, the expenses are increased. Inspections, maintenance, extra freights, and quarantine fees on 11 head of Guernsey cattle amounted to over £84. The whole of this could have been saved if the stock had gone straight to the boat, the same practically as the Channel Island stock do going to America. Secondly, the accommodation in quarantine, which is limited, is taken up unnecessarily and so prevents other stock urgently required from going in. For example, one of my clients cabled from Australia requesting me to purchase Southdown sheep. On account of all space being taken in the quarantine station I was prevented from buying. Unfortunately the order has not yet been filled.

With regard to expenses, many people have the idea that importing stock is a rich man's hobby and that costs do not count. This is a very serious error of judgment. Quite a number would import and go short themselves for a long time if all costs were cut down to a minimum, and there is no doubt that small

men financially importing will give greater personal attention to stock, and that in a very short time Australia would benefit and, in turn again, the Empire also.

This no doubt was what originated the Empire Marketing Scheme for which I and others are truly grateful, and I venture to say that if the scheme is carried on for a few years there will be a great outlet for the stud breeders at Home—a great gain in better stock at this end and ultimately more suitable products for the markets at Home and abroad.

It is with the object of assisting, possibly in a very small way towards this end, that I have subscribed these notes, and if I can help directly or indirectly in the future with this work I shall be pleased to do so.

ESTIMATED SAVING IN COSTS IN THE DIFFERENT METHODS OF FEEDING, ETC.

The ships average about 31 days out from London to W.A. (where supplies can, if necessary, be obtained) and are about 10 days on the Australian coast before reaching Melbourne, therefore 40 days' allowance should be sufficient.

Cattle, say 25lb. meadow hay daily x 40 days (or say ½ ton per adult head)—1,000lb.

Sheep, say 4lb. meadow hay daily x 40 days—160lb.

Cattle—2 bulls, 11 heifers, say 6½ tons; 2 yearling heifers, 2 calves, say 1 ton; 18 sheep, say 1½ tons. Total 9 tons.

	£	s.	d.
9 tons meadow hay at £6 10s. per ton	58	10	0
1 ton crushed oats	10	0	0
Allow for new bags, trucking and various expenses say ..	12	10	0
5 cwt. straw for 15 head, say 5 tons at £2 5s. per ton	11	5	0
	£92	5	0

No straw required for sheep and half that now allowed for cattle would be ample. No roots in this estimate. One ton used on voyage.

The fodder and straw for the animals on the "Matakana" cost £191 12s. 6d., so that I estimate a considerable saving could have been effected; but, as already stated, over 160 bags of chaff, surplus hay and straw, etc., were not allowed to land. Therefore, less space for fodder would be wanted on the voyage, and if other accommodation than the boxes referred to could be provided (which are dumped), it is possible that further economies could be effected.

Had the stock (11 head of Guernsey) gone straight to the boat instead of into quarantine a further saving of £84 would have been effected.

PRODUCERS' MARKETS CO-OPERATIVE, LIMITED,

QUARTERLY REPORT ENDING 30th MAY, 1932.

Fruit.

Apple supplies during the quarter were heavy, prime lines being in good demand, but inferior fruit sold at low values. New Season Navels sold at steady values, and values for Lemons firmed towards the end of the quarter. Mandarins of good quality firm and good variety. Pears in demand.

Vegetables.

Heavy supplies of all lines of vegetables were forward during the quarter. Potatoes were in steady demand and values were firmer than the corresponding period for some years. Pumpkin values were consistently low and inferior quality was hard to quit. Swedes were not so plentiful and a steady demand existed for prime lines. Cabbage was short during March and values were then good, but later supplies increased and values receded. Beans were glutted during the whole time and values were below a paying price. Peas were moderately supplied to a steady market, with values good. Sweet Potatoes were about equal to the demand. Cauliflowers started early in the period and supplies were heavy from jump; values were easy for prime lines, and inferior lines at glut level. This had a weakening effect on other lines, principally Cabbage and Beans. Rhubarb heavily supplied and values low. Celery also heavily supplied and the demand was weak, even prime lines being hard to quit at satisfactory prices. Bunch lines consistently heavy throughout with values only fair. Lettuce maintained a steady price and special lines were high.

Eggs.

During the quarter under review egg supplies were considerably decreased in quantity. Values were not so high this year as last, due to Cool Store eggs being in demand, and to the effects of the depression. It has been noticeable that once the eggs realised over 2s. the consumption eased. On the average eggs have been firm at prices ranging from 1s. 9d. to 1s. 11d. for metropolitan new laid.

Poultry.

During the quarter under review supplies have been heavier, with all lines well supplied. Cockerels and Black Hens have sold at satisfactory values. Muscovy Ducks and Drakes over-supplied were hard to quit even at low values. Turkey Hens and Gobblers heavily supplied towards the end of the quarter, but the quality offering was not up to the requirements of the trade.

LIVE STOCK AND MEAT.

For the information of readers of this "Journal," the following particulars have been supplied by Messrs. Elder, Smith, and Coy., Ltd., Perth:—

COMPARATIVE NUMBERS OF STOCK SOLD AT METROPOLITAN FAT STOCK MARKETS, FOR MONTHS OF MARCH, APRIL AND MAY, 1932.

	March.					April.				May.			
	2nd.	9th.	16th.	23rd.	30th.	6th.	13th.	20th.	27th.	4th.	11th.	18th.	25th.
Sheep	10,586	8,391	8,298	9,564	7,875	9,550	11,585	10,657	8,297	8,392	10,699	11,298	10,144
Cattle	535	500	564	605	487	582	615	546	580	530	482	467	503
Pigs	1,633	1,455	1,441	1,412	1,555	1,691	1,397	1,656	1,286	1,459	1,381	1,500	1,621

COMPARATIVE VALUES PER POUND.

	March.					April.				May.			
	2nd.	9th.	16th.	23rd.	30th.	6th.	13th.	20th.	27th.	4th.	11th.	18th.	25th.
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
Mutton ...	3½	3½	3½	3½	4	4	4	4	4½	4¾	4½	3¾	3¼
Beef	4½	4½	4½	4½	4½	4½	4½	4	4	4	5½	5¾	6
Pork	6½	6½	6½	6½	6½	6½	6½	6½	6½	6½	6½	6½	6½
Bacon	5½	5½	5½	5½	5½	5½	5½	5½	5½	5½	5½	5	5

MARKET REPORT.

Messrs. H. J. Wigmore & Co., Ltd., of Wellington Street, Perth, have supplied us with the following information regarding the chaff available for auction at the Perth Railway Yards, for the period March to May, inclusive:—

	Quantity (figures include all qualities of Wheaten and Oaten Chaff).	Minimum Price f.a.q. to Prime Wheaten.	Maximum Price f.a.q. to Prime Wheaten.
	tons.	£ s. d.	£ s. d.
March, 1932 ...	985	4 5 0	4 12 6
April „	1,220	4 5 0	4 15 0
May „	785	4 12 6	4 17 6

It will be seen from the figures quoted above that the market has had a firming tendency. This result, however, has to a large extent been caused by the fact that a very considerable proportion of the chaff offered for sale at auction apparently has not reached owners' ideas of value, and has been stored in Perth and Fremantle. Such action, of course, has had the effect of temporarily firming the market, but the position cannot be considered a healthy one and the methods adopted may result in lower prices as the stored chaff is put into consumption. Our considered opinion is that farmers holding supplies should lose no time in marketing.

Oaten Chaff:—There is a fair inquiry for oaten chaff of all qualities. Prime was selling in March at from £4 5s. to £4 10s., in April at the same figures, and in May at £4 10s. to £4 12s. 6d. per ton; f.a.q. at about 5s. per ton lower.

Oats:—During the period under review supplies have been far from plentiful, and with a good inquiry the market has remained firm, good heavy feeds selling at from 2s. 1d. to 2s. 4½d.; good feeds at from 1s. 8d. to 2s. per bushel.

Wheat:—In March, f.a.q. sold as high as 3s. 6d. per bushel. In the same month second grade realised up to 3s. 4d. In April the maximum price for f.a.q. was 3s. 4½d., the same having been secured in May.

We have a very good inquiry for all produce lines mentioned above, and farmers consigning to us for sale at auction can be assured of securing the highest market rates.

METEOROLOGICAL INFORMATION.

STATIONS.	TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.	
	Maximum		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.
	Mean.	Highest.	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.		
	MARCH.						APRIL.						MAY.					
					inches.	inches.					inches.	inches.					inches.	inches.
Chapman State Farm	90·0	104·3	62·4	54·5	0·61	0·63	80·8	91·3	57·5	50·3	1·13	0·45	...	...	...	...	...	2·43
Geraldton	83·8	98·0	63·7	50·4	1·65	0·45	79·2	90·0	61·8	53·0	1·01	0·82	76·1	88·0	59·7	50·0	2·12	2·82
Walebing	84·9	103·0	57·6	50·0	2·14	0·75	...	...	...	...	...	0·80	...	...	...	...	...	2·63
Perth	79·6	96·7	60·7	50·2	0·17	0·78	74·4	87·1	57·2	48·1	3·16	1·68	70·1	83·0	55·0	45·0	8·22	5·07
Kalamunda	79·4	94·5	57·0	46·9	0·36	0·83	71·7	84·9	54·6	47·2	4·15	1·96	66·9	80·0	52·0	45·0	11·06	6·08
Bunbury	75·6	86·0	55·4	47·0	0·98	0·99	72·3	83·0	52·5	40·0	1·38	1·71	68·5	77·5	51·4	43·0	4·38	5·23
Bridgetown	79·0	93·0	48·3	34·8	0·87	1·04	74·1	86·8	46·2	35·0	1·88	1·72	67·7	82·5	44·2	29·8	6·17	4·62
Albany	70·6	83·6	58·0	52·0	1·35	1·54	70·4	82·6	54·1	45·0	1·81	2·77	66·9	83·0	50·9	40·8	4·77	5·01
Merredin State Farm	83·3	95·8	57·1	47·2	0·59	1·04	75·4	87·9	52·7	40·0	0·42	0·84	70·1	81·2	50·7	39·6	1·60	1·34
Northam	85·2	99·0	57·5	47·0	0·28	0·73	77·2	90·4	53·9	44·0	1·80	0·81	71·0	83·0	49·6	40·0	3·92	2·22
York	83·6	97·0	56·1	44·5	0·23	0·63	75·8	88·8	51·7	42·0	1·49	0·81	69·8	81·5	48·2	36·5	4·78	2·31
Narrogin State Farm	79·6	92·1	50·9	39·0	0·84	0·80	71·8	82·4	48·3	40·4	2·10	1·16	66·4	77·6	46·4	37·0	5·41	2·81
Katanning	78·0	92·0	52·2	42·7	0·65	0·96	72·0	84·0	49·3	40·0	1·57	1·18	66·4	80·0	47·1	33·6	4·61	2·36
Cape Leeuwin ...	71·8	86·2	61·4	57·0	0·44	1·22	70·2	83·0	60·9	50·0	2·43	2·25	66·7	80·2	56·6	49·8	8·96	5·77

WESTERN AUSTRALIA—DEPARTMENT OF AGRICULTURE.

LIST OF BULLETINS AVAILABLE FOR DISTRIBUTION.

No. 20.—*The Pruning of Fruit Trees.* J. F. Moody. Price 2s. 6d.
No. 24.—*Hints to Stock Breeders* (revised). R. E. Weir.
No. 37.—*Conference of Producers,* 1910 *and* 1912.
No. 46.—*Fruit Packing and Marketing and Exporting of Fruit.* J. F. Moody and J. Ramage. Price 1s. 6d.
No. 49.—*The Feeding of Horses.* Professor Paterson and G. L. Sutton.
No. 57.—*Vermin Destruction.* A. Crawford.
No. 60.—*The Farmer's Clip.* J. J. Mahood.
No. 68.—*Flaying and Treatment of Hides.* R. E. Weir.
No. 74.—*Tobacco Cultivation.* A. R. C. Clifton.
No. 79.—*Sheep on the Wheat Farm and their Management in W.A.* H. McCallum.
No. 83.—*Horticulture and Viticulture.* A. Despeissis. Price 2s.
No. 88.—*Light Land: Conference.* G. L. Sutton.
No. 90.—*Stock Waters: Standard for Composition of.* E. A. Mann.
No. 91.—*Dairy Premises.* P. G. Hampshire.
No. 93.—*The Home Tanning of Sheep and other Skins.* H. Salt.
No. 96.—*Poison Plants of W.A.* D. A. Herbert.
No. 99.—*Australian White.* G. L. Sutton.
No. 101.—*Cotton Cultivation.* G. L. Sutton.
No. 103.—*Kerosene Method for Eradicating Zamia Palm.* G. K. Baron-Hay.
No. 105.—*Pedigree Selection of Seed.* G. L. Sutton.
No. 106.—*The Red Legged Velvet Earth Mite.* L. J. Newman.
No. 112.—*Automatic Device for Eradication of Stickfast Flea.* G. Allman.
No. 113.—*Picked Pieces: Classification of Clip.*
No. 114.—*Blue Mould on Citrus Fruits.* W. M. Carne.
No. 115.—*The Value of Windmills for Pumping Water in W.A.* A. H. Scott.
No. 117.—*Cream.* P. G. Hampshire.
No. 149.—*Lucerne.* G. L. Sutton.
No. 192.—*Root Rot.* A. J. Despeissis.
No. 220.—*Irrigation and Drainage.* A. H. Scott.
No. 221.—*Soudan Grass.* G. L. Sutton.
No. 225.—*Subterranean Clover.* G. K. Baron-Hay.
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